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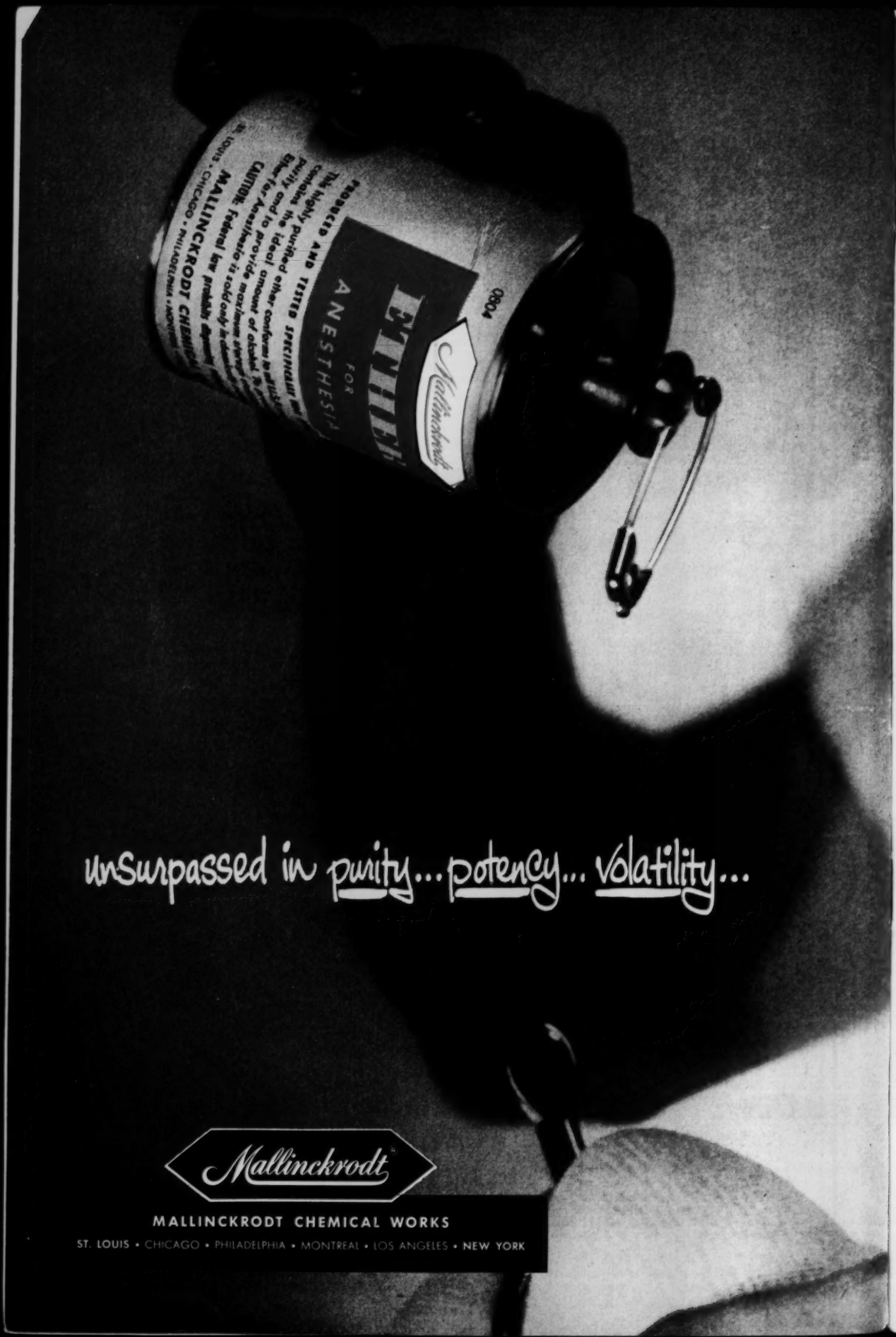
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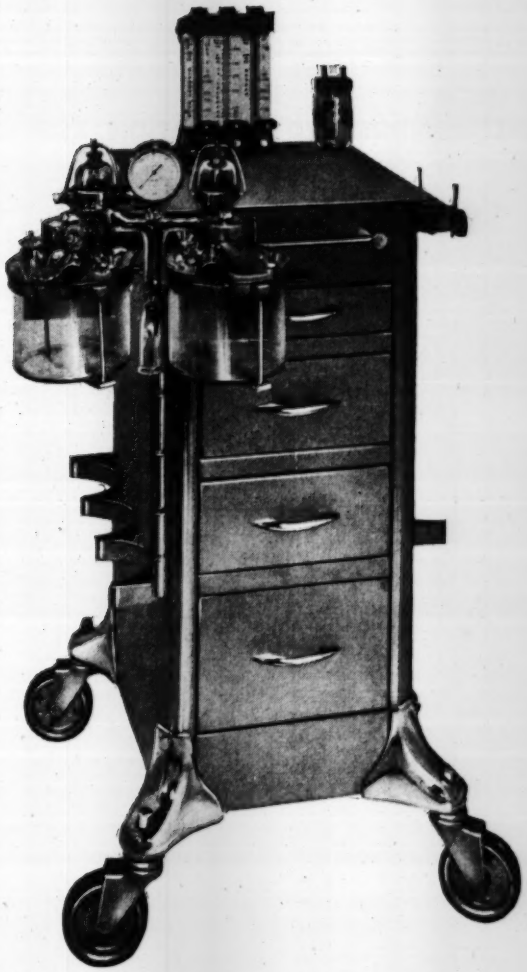

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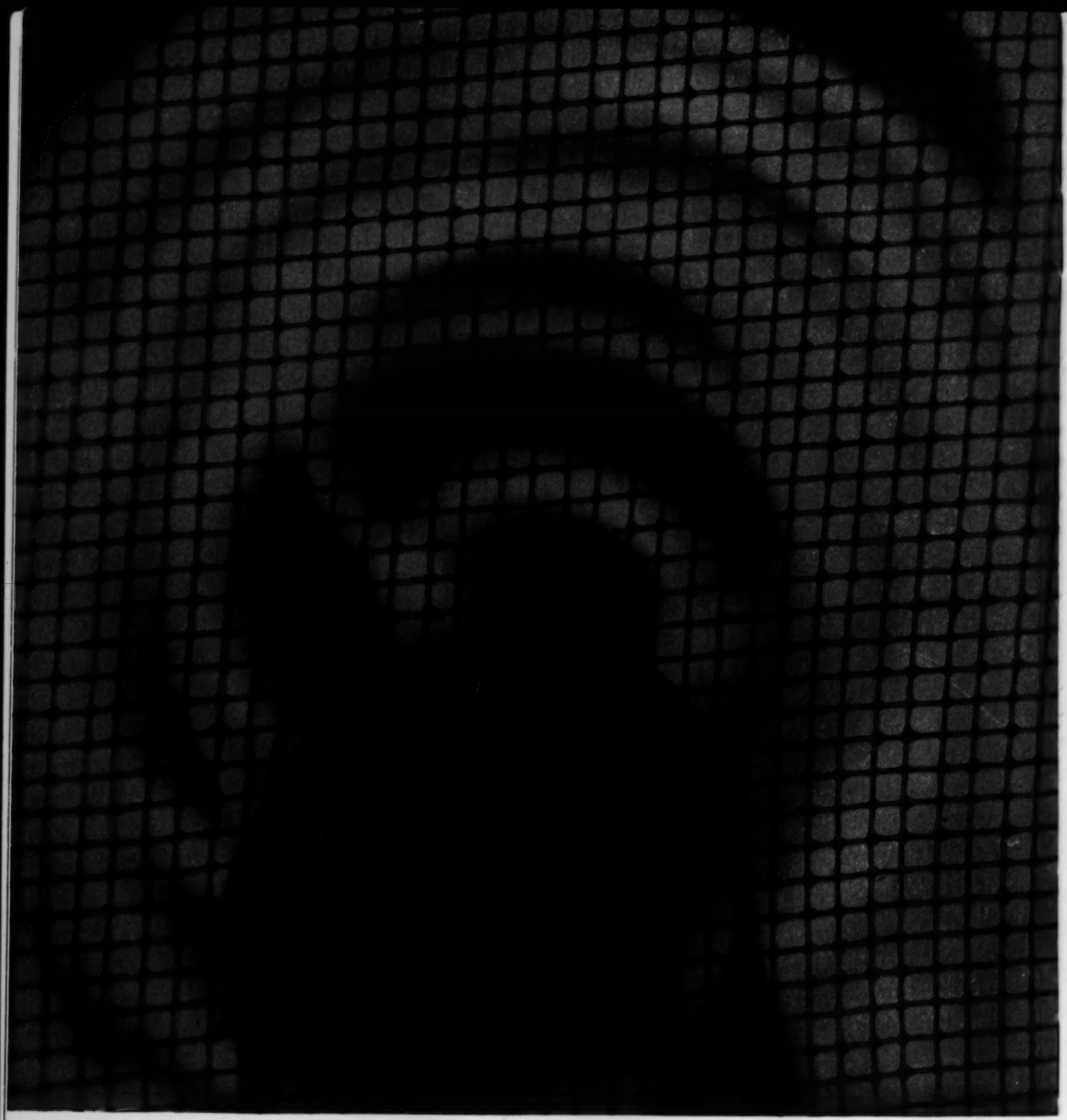

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Pediatric Anesthesia

John S. Lundy, M.D.*
Rochester, Minn.

The technic of the administration of anesthetic agents to infants 2 years old or less, and to children 2 years old and as old as 8 or 10 years is not too much different from that used for anesthetizing adult persons, except that the patient is small. However, small size occasionally is advantageous if hypothermia is to be used in connection with anesthesia and a thoracic operation. It is, of course, much easier to reduce a child's body temperature than an adult's, and reduction can be done more quickly, as can an increase, so that there is less time and effort consumed than would be true if the patient were an adult.

Certain differences do arise, however, between anesthesia for a child and anesthesia for an adult person. If, for instance, a volatile anesthetic agent is to be used, not nearly as much is required for the child as for the adult patient, but when gaseous anesthetic agents are given this difference does not obtain—the percentage of gas and oxygen in the mixture is the same, whether an adult or a child receives it. However, there will be a difference in the volume flow of the oxygen, and there must be a significant difference in the size of the gas machine. If the machine is the circle absorber type, the valves must be smaller and breathing tubes must be smaller, or alternatives are to employ a gas machine made for use with infants or an arrangement in which the breathing bag is close to the patient's face.

From the standpoint of fluid balance, it is desirable that a definite hour be set for the operation, so that the child will not remain too long without food and fluids.

Atropine in doses from 1/400 grain for an infant 6 months old or up to 1/150 grain for a 10-year-old and older is valuable before most anesthetic agents are given. Morphine may be given in small doses, such as 1/8 grain at 12 years, 1/24 grain at 8 years and 1/48 grain at 3 years. Usually, morphine is unnecessary if the child is less than 3 years old, since pentothal sodium for rectal administration is available. I have no use for meperidine hydrochloride (demerol), and I hope it will

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*Read at the Institute for Nurse Anesthetists sponsored by the American Hospital Association, and American Association of Nurse Anesthetists Portland, Oregon, January 27, 1955.

Section of Anesthesiology and Intravenous Therapy, Mayo Clinic and Mayo Foundation.
The Mayo Foundation, Rochester, Minnesota, is a part of the Graduate School of the University of Minnesota.

be outlawed, as heroin is now. No virtue that it might possess will ever relieve it of the curse of addiction that it has laid even upon our own profession.

I find generally satisfactory the rectal administration of a 10 per cent solution of pentothal sodium, calculated on the basis of 0.2 cc. per pound of body weight. When this is done, the patient usually will be asleep by the time the operating room is reached. Anesthetization may then be carried out with whatever agent it is decided to use. Rectal anesthesia with pentothal sodium or avertin followed by inhalation anesthesia should not exceed 10 minutes for the latter, including intubation.

When it is not desirable to use gas, and the semiopen method is employed, it is usually best to administer some oxygen through a catheter under the mask, so that there need be no dependence on the oxygen of the ambient air for oxygenation of the patient. An intratracheal tube probably is more effective for use in a child than it is in an adult person. A nasopharyngeal tube or an oropharyngeal tube often is satisfactory for children as well as adults for some operations, such as on the eye or the ear. That is not to say that the percentage of success in a series of cases will be as high when a pharyngeal airway is employed as when an intratracheal tube is used. Actually, children are not so well developed as adult persons in their reflexes, musculature or bones. None the less, in some ways they probably are better equipped than adult persons, because their vital organs have been subjected to less stress. My impression is that in the matter of regeneration of capacity in, let us say, an organ like the liver, children enjoy superior powers.

If, in the course of anesthesia, a child does not breathe, it must be assumed that an overdose of anesthetic agent has been administered. The treatment, of course, is the same as it would be for respiratory obstruction, but the rationale is somewhat different. In Stephen's excellent book, **Elements of Pediatric Anesthesia,**[1] it is pointed out that a sleeping infant may require only a very small amount of air with each inspiration—anywhere from 20 to 60 cc. Yet the same infant, when he is crying vigorously, may require 180 cc. of air. This difference of 100 cc. or so is maximal, because the infant's need is rather small compared to the figure of 1,800 cc. of residual air and about 400 cc. of tidal air for an adult person. It is seen, then, that the child does not have the balance of safety in terms of oxygen that an adult person enjoys. This means that, whereas an adult person may maintain himself as long as 2 minutes without breathing and without particular danger, a child must not be allowed to cease breathing for longer than 1 minute.

Stephen also points out that an infant will breathe normally between 30 to 45 times a minute, while a child breathes 20 to 30 times a minute. Under anesthesia, however, if an infant breathes more than 60 times a minute and a child more than 40 times a

1. Stephen, C. R.: Elements of Pediatric Anesthesia. Springfield, Illinois, Charles C Thomas, 1954, 109 pp.

minute, something probably has gone wrong, and the situation must be investigated for respiratory obstruction, resistance in the machine, presence of too much carbon dioxide and dead space, stimuli which are painful because anesthesia is not deep enough, or too small a flow of oxygen as well as perhaps too small a percentage of oxygen. The pulse of an infant may be extremely fast. It may vary from 100 to 200, whereas that of a child may vary from 75 to 150 without signifying evidence of difficulty.

As far as blood pressure is concerned, in the newborn infant it will be about 75 systolic and 50 diastolic, in millimeters of mercury. This pressure will increase to 100 systolic and 70 diastolic at the end of the first 2 to 3 weeks, and will not change much until the child is about 5 years old. Blood pressure in the infant and the small child is affected by preliminary medication, which can diminish the pressure as much as 25 to 30 mm., systolic.

In my own method of taking blood pressure by watching the oscillation of the needle on the dial, I find that results usually are better when a special narrow cuff is applied to the child's thigh rather than when the cuff on the arm is used. The arm can be used to obtain blood pressure, but the use of a cuff to take readings of blood pressure is not always satisfactory when abnormalities exist. The situation is most secure if the anesthesiologist is aware of such abnormalities before the anesthesia is started. Sudden change in color in an infant during a major surgical operation is a sign, as a rule, of a serious change in the patient's condition. If the patient's condition becomes critical and the difficulty cannot be ascertained, it is safer to ventilate the patient at once with pure oxygen by artificial respiration than to lose critical time in trying further to determine the trouble. In other words, if the cause of the difficulty is not readily apparent, oxygen should be administered, and it should be done by alternately gently squeezing the patient's chest, followed by gentle pressure on the breathing bag. Delay in carrying out this maneuver may be fatal. It may be advisable, too, to assist respiration periodically, but for only a short time. It is best that the patient breathe automatically at least part of the time, even though this type of breathing may not be full enough to constitute adequate breathing. Then, too, the pH of the blood may be interfered with if too much assisted respiration is attempted.

Vomiting and aspiration of stomach contents frequently happen during anesthesia in children. This means that the inspiratory passage must be cleaned out and kept patent. It should be remembered that a little fluid in a child's trachea is just as effective in producing respiratory obstruction as solid material.

Convulsions occasionally occur during anesthesia in children. These usually can be controlled with a small dose of a barbiturate administered intravenously, plus the use of oxygen. If the body heat increases markedly, cool sponge baths are helpful. When infants are to undergo major

operations, it should almost be routine, after anesthesia has been produced, to put a needle in the vein and to administer some fluid very slowly. Even if the amount of blood lost is small, it should be replaced. A child does not tolerate even a small hemorrhage well.

The method I employ for anesthetizing infants and children for cardiac catheterization follows. In the past, small children could not be maintained well for this diagnostic procedure by means of local anesthesia. The most satisfactory technic I have employed to ensure that the child will be relatively safe and yet remain quiet enough to permit insertion and viewing of the catheter through the fluoroscope without interference is to administer by rectum 100 mg. of a 2.5 per cent solution of tribromoethanol (avertin) per kilogram of body weight to the infant or child when he has been placed upon the fluoroscopic table. As soon as the child is asleep (and incidentally, at that time his veins will have reached a probable maximum of dilatation), a 20-gauge needle is inserted into a vein and 1 cc. of isotonic solution of sodium chloride is injected to make sure the needle is in the lumen of the vein. This needle is then connected to a Y-piece and the Y-piece is connected to two syringes, one through each branch of the Y. In the one syringe is isotonic solution of sodium chloride and in the other syringe is a 2.5 per cent or less solution of pentothal sodium. For the safety of the child it is best not to inject the solution of pentothal sodium until it is needed. Therefore, the isotonic solution of sodium chloride permits testing to ensure that venipuncture is satisfactory, without concurrent administration of the solution of pentothal sodium. Pentothal sodium, however, should be administered slowly whenever the effect of the solution of tribromoethanol begins to wear off and the child begins to move. On rare occasions, the child undergoing cardiac catheterization may require intubation for the adequate intermittent administration of oxygen in the event that respirations fail because the dose of the anesthetic agent that was estimated proves to be too large for the child when it has exerted its peak effect.

For intubation of an infant or a small child, the first step is to select an intratracheal tube by measuring the bevel of the tube against the fingernail of the child's little finger. If the bevel does not exceed the width of the nail, it will pass through the rima of the glottis and into the trachea without effort. In these small patients it is well not to insert the tip of the tube more than 1 inch beyond the vocal cords. If the patient coughs, the tube should be withdrawn slightly, because the point probably is touching the bifurcation of the trachea. Particularly when the left side of the thorax does not expand, it is likely that the tube has been inserted into the right main bronchus. If this happens, it will produce a bizarre pattern of breathing, and it will be hard to decide what has affected the breathing unless the tube is moved back and forth to prove whether the tube is in the trachea or in a bronchus. Gentleness, of course, should be

used in both intubation and extubation.

As a rule, regional or spinal anesthesia is not used for children. Either procedure can be used, however. It is true that infiltration of a local anesthetic agent in dilute solution in the line of incision can be helpful in reducing the degree of general anesthesia necessary. Occasionally, a surgeon may wish to repair a tracheo-esophageal fistula with the patient under the influence of local anesthesia. Sooner or later, however, it will be found that general anesthesia is required. I prefer to produce general anesthesia first, inserting an intratracheal tube, and then, if the surgeon wishes to use a local anesthetic agent, to administer it as an additive to the general anesthesia.

Among the commonest operations on children are tonsillectomy and adenoidectomy. For the most part, if the patient for such an operation is 10 years old or less, I prefer to administer pentothal sodium rectally, as mentioned previously, bring him to the operating room and then administer nitrous oxide, oxygen and ether by inhalation, and institute intubation either through the mouth or through the nose. If the tonsils are to be removed first, it is a little more convenient for me if the tube is inserted through the nose. With the tube so placed, if the patient is small and the surgeon is not sure whether he can remove the adenoids satisfactorily, the change from nasal intubation to oral intubation can be carried out in a moment. Generally speaking, I think most surgeons prefer that the tube be inserted through the mouth, and that it be moved from one side of the mouth to the other as required. This is not so convenient for the one who administers the anesthetic agent. If tonsillectomy is to be performed, and the tube can be inserted through the nose, it of course does not have to be moved during the operation. A point to remember is that a tube can be inserted such a short distance beyond the vocal cords that it may be withdrawn too easily from the larynx. In the middle of an operation this can be very unsatisfactory.

One of my worst experiences involved tonsillectomy for a patient who had been receiving cortisone. Then the use of cortisone was discontinued. Because of difficulty in intubation, an attempt was made to operate without a tube. This was almost disastrous. The patient bled profusely and he also bled at intervals of several days during convalescence. Eventually he made a remarkable recovery, but I should not wish to attempt another such session of anesthesia until a tube had been placed properly.

For short operations, such as measurement of the pressure of the eyeball, examination of the optic fundus and myringotomy, almost any of the inhalation anesthetic agents can be employed. I do not use trichloroethylene in such cases if vinyl ether (vinethene) is available or if nitrous oxide and oxygen are at hand. For anesthesia during operations to correct pyloric stenosis I never have found anything more satisfactory than ethylene and oxygen, with a minute addition of ether. Excellent results, how-

ever, can be obtained by the use of nitrous oxide and oxygen, with an extremely small dose of curare, and with infiltration of the line of incision in the abdominal wall. For anesthesia during any thoracic and most abdominal operations on a child, I prefer to use an intratracheal tube. Ayre's T-piece or a non-rebreathing valve can be very useful indeed, especially during operations for harelip and cleft palate. In anesthesia for neurosurgical procedures a tube is of great value, because it allows the patient to be ventilated in the event that difficulties arise. For the extraction of one to three teeth, anesthesia with nitrous oxide and oxygen administered by nasal mask is very satisfactory. The flow of gas, however, needs to be fairly large, perhaps 17 liters of nitrous oxide per minute, with 6 liters of oxygen or more if necessary. The important factor in the administration of nitrous oxide and oxygen with a nasal mask for dental operations is to ensure that the flow of the two gases is sufficient to blow the ambient air from the respiratory passages. If a considerable number of teeth are to be extracted or if the operation is to be longer than 10 minutes, it probably would be wise to anesthetize the patient by means of intubation through the nose, so that he may be very safe throughout anesthesia and operation.

The new analgesic and anesthetic agent, dolitrone, may become useful for children, but as yet its main use has been in adults for dental operations.[2;3;4] However, it has been used at least once as an analgesic agent for changing of dressings after a severe burn in a 3-year-old child. The analgesia was superior to that obtained with trichoroethylene or cyclopropane.

The person who is to administer an anesthetic or analgesic agent to a child must be experienced, and must be one who will check every detail in advance. Whatever is to be used must be tried before it is needed. It should be assured that full tanks of gases are at hand. It must be known that connections fit. Laryngoscopes must be functioning, and two of them should be available.

Suction apparatus and tubes and sucker tips must fit and function. Administration of an anesthetic agent should not be started until the suction outfit is ready and at hand.

Why is it so important to check in advance everything that is to be used for anesthesia? The answer is that there is scarcely ever more than 1 minute available in which to rescue the helpless patient from serious danger or even death when difficulties arise. With care and experience, it is possible to anesthetize almost any patient with relative safety, if that patient is able also to tolerate the operation.

2. Lundy, J. S.: 110 Years of Anesthesia. J. M. A. Georgia. 43:195-200 (Mar.) 1954.
3. Lundy, J. S.: Development of Analgesia After a Century of Anesthesia. J.A.M.A. (In press.)
4. Lundy, J. S.: Hope for an Age of Analgesia. J. Am. A. Nurse Anesthetists. 22:225-228 (Nov.) 1954.

The Humane Approach To The Patient

Lester Rumble, Jr. M.D.*
Atlanta, Georgia

The Art of Anesthesia is too often entirely forgotten in this era of mass production. Anesthetists forget that an operation is a once in a lifetime event for most patients. The lack of frequent contact between patient and anesthetist makes difficult the establishment of understanding between the two. It is urgent that each patient be approached as an individual, keeping always in mind that this will most likely be his only contact with anesthesia.

In the capacity of an anesthesiologist it is possible to pay a visit to each patient pre-operatively. This visit is important from two aspects. First, an evaluation of the physical condition of the patient is helpful in planning anesthetic management. Just as important is the establishment of a physician-patient relationship through the explanation to the patient of the course of events leading up to the administration of anesthesia. In some instances, Nurse Anesthetists can make preoperative visits. More frequently, they must rely on the surgeon to perform this task and unfortunately most surgeons do not take time to explain much regarding anesthesia.

Dr. Willard L. Sperry,[1] Dean of the Divinity School at Harvard University states the case from the patients' viewpoint. He speaks from a personal standpoint, having undergone several hospital experiences. I quote:

"Let me state the case from the patient's viewpoint. He is due for a major operation. He goes into hospital at 5 p.m. His watch and his wallet are left at the desk. His clothes are stored away. He is put into a 'johnny' and put to bed. A johnny is undoubtedly an ideal garment for its purposes, but is an awkward and rather humiliating substitute for pajamas. At about 5:30 he has an austere meal of clear weak tea, and unbuttered toast. Somewhere after six a competent looking woman, a technician, comes in and draws some blood from the ear and then a larger amount from the vein inside the elbow joint. She packs up her apparatus and leaves without saying a word. An hour later a nurse comes in and announces

Presented at the Atlanta Institute, Monday, February 28, 1955.

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1. Sperry, William L.: Editorial, Anesthesiology, Oct. Nov., 1952.

that she is going to bathe you. This unfamiliar and semi-humiliating procedure is accepted. She is followed by an orderly who 'finishes' the bath by dealing with the more intimate parts of the body. Eventually another orderly arrives and proceeds to shave the prospectively involved surfaces of the body. All this is familiar routine with you. But you should realize that to the patient it is, for the first time at least, a rather cold-blooded proceeding.

"It is probable that at this stage of the game, shall we say 8 p.m., the family doctor looks in to give a friendly and reassuring word, and then the surgeon-of-the-morrow comes in to say much the same thing. Up to date the proceedings have been definitely impersonal. These two final visits are more intimate. The final act in this drama remains to be enacted about 6 o'clock the next morning—the enema. It is undoubtedly necessary, but if the patient has been lucky enough to get a little sleep and has to be roused from troubled sleep for this proceeding it is a peculiarly unappetizing initiation into his big day. Now all this has been competently and efficiently done and the patient ought probably to try to see these various transactions from the standpoint of nurses, orderlies and the like.

"There has been in his mind, however, one question which he may not have plucked up courage to ask, 'What kind of anesthesia am I to have?' Or, if he asked the question, he has been fobbed off by the doctor or surgeon, being told, 'We will decide that when we see the anesthesiologist tomorrow morning.' It may not occur to you, in your specialized field, that this matter has any advance interest to a patient. But I can assure you that it does. He often lies awake for hours during the first half of the night thinking about it.

"The patient may be the type of person who is very reluctant to take ether and hand over his consciousness to the anesthesiologist. Or, again, he may be the sort who asks nothing better than to be entirely out of the picture while on the operating table and therefore averse to anything like a spinal or local anesthetic. These are vague psychological matters and not entitled to serious consideration on the part of the doctor or surgeon. The surgeon has a right to see that the anesthetic most suitable for his purposes is used and it is the patient's plain duty to accept that fact. Nevertheless he would be got aboard the trolley, into the operating room and onto the table in a more relaxed frame of mind if he knew what was going to happen next. The medication given him while he is still in bed may dull his perceptions somewhat, but he still has wits enough to know what is going on and to have at least a certain curiosity, if not apprehension, about it.

"I have never ceased to wish, during the long and often sleepless night before an operation, that the anesthesiologist might have looked in to tell me what he was proposing to do in the morning. A major operation is, in the very nature of the case, for the patient a venture into the unknown. The patient has made his peace with that fact. But he would like to know by what door

he is to be inducted into the unknown."

It is easy to understand this patient's viewpoint. Some of the fears which beset candidates for surgery were discussed recently by Drs. Hornick, Corman and Jackson.[2] In approaching surgery, the patient gives up all of his self-sufficiency and places himself in the hands of almost complete strangers. This in itself is enough to bring forth a reaction of resistance. At ages of one and two years a child has only a fear of abandonment, and the experience of anesthesia is apparently not recalled in later life. The fear of dismemberment or mutilation is developed at the age of three or four years, while the fear of death develops in the five year old. Throughout this period, painful experience is associated with a visit by a doctor or a nurse. Much of the fear of anesthesia found in the later years, stems from the administration of ether for tonsillectomy during these early years of life. In a four and one-half year study of patients for tonsillectomy at the Massachusetts General Hospital[2] 80% of the youngsters ages one to five feared hospitalization. In the age group of ten to thirteen only 10% feared hospitalization whereas 60% feared narcosis.

In later life other anxieties beset the patient. Fear of disfigurement, dissection, disability and disgrace are many times manifested by patients who must have surgery. These are all added to a fear of anesthesia. In a study of 43 adult patients selected at random, 34 of them expressed definite fears. Fifteen had fear regarding hospitalization, thinking they might have cancer. Twenty-two feared anesthesia, 8 of these feared sleep, 4 feared ether, 4 feared spinal and 2 feared local. Two were afraid of suffocation and 2 were afraid of what they might say.

The prospect of surgery is expected to be a stress situation in almost every patient. Anxiety becomes pathological only in relation to intensity and to the degree to which it incapacitates the individual. The absence of anxiety can also be pathological and can be a poor prognostic sign. Patients who have been depressed pre-operatively may be more prone to prolonged convalescence. The premonition of death, however, seems to have no relationship to the incidence of anesthetic deaths. Much of this anxiety can be relieved by a frank discussion of anesthetic procedures and an understanding by the patient that a competent individual will be there to watch over his well-being while under anesthesia.

There are other considerations equally as important as the pre-operative visit in allaying these fears. The atmosphere of all operating theaters should be quiet and serene. Loud talking, the dropping of instruments and pans, the noisy movement of equipment and many other sources of disturbance can be eliminated. The transportation of patients should be scheduled so as to avoid a long waiting period in the corridor of the operating rooms. If the patient must be left in the hall, be certain that it is im-

2. Corman, Harvey H., Hornick, Edward J., Jackson, Katherine: Panel Discussion, New York Post Graduate Assembly, 1954.

possible for him to observe the activity within the room itself. In spite of adequate premedication the sight of an operation in progress can be most unnerving to many individuals.

Conversations in the room while the patient is awake must be guarded. A question about the availability of a blood transfusion has been responsible for the development of hysteria, with a resulting stormy induction and anesthetic course. Keep in mind that the sense of hearing is one of the last to be obtunded during induction. Recently, the scrub nurse unwittingly made necessary the supplementation of an otherwise satisfactory spinal anesthetic with the clearly audible remark "I hope I don't faint this time. Last time when they sawed the bone and that leg fell off I fainted dead away on the floor." Imagine the effect of such a remark on the already depressed patient. Many other such remarks in our everyday routine can strike fear into the heart of the most stoic patient.

When the patient is first approached, introduce yourself and call him by name. This serves to let him know that someone is there to watch over his stay in the operating room. If you have seen him pre-operatively, he feels as if he has found a friend in a strange place. If the surgeon is thoughtful he will speak to the patient and introduce you to him. From that point on, be certain to explain each motion that involves the patient. Explanations cannot be detailed, but should be calculated to answer his questions. Many times we see a complete disregard for the patient's query as to why certain things are done. Answers can be given in a manner which best suits the patient's mood. If he is putting up a good front then the answers can be given in a humorous manner. If he evidences real concern, then it is well to adopt a tone of sincerity. Throughout this period the impression should be gained that you know what you are doing and that every effort is being directed toward his comfort and safety.

Too often the patient is not informed soon enough of what is taking place. Advance notice of strange or painful sensations will have a calming effect on nearly all patients. The Bovi plate is cold, the prep solution is cold, alcohol burns slightly on recently shaved areas, pentothal and surital taste like garlic shortly after intravenous injection, the onset of spinal analgesia feels like "needles and pins", novocaine burns when injected, a tourniqet is tight around the arm. Many more advance warnings can change an apprehensive patient into a cooperative subject.

Throughout this time no motion should be made with haste. Equipment should be so arranged as to allow ready access to it without a great deal of motion. Any movement of the patient must be slow and gentle. To suddenly grab an arm and place it on an arm board can cause involuntary resistance even by the most relaxed patient. In these days of swift barbiturate induction the use of restraining straps and cuffs is almost obsolete. No longer should it be necessary to frighten the patient by physical restraint. Such straps may be necessary once the induction period is over,

but the patient is not aware of them. Face masks, should never be strapped on a conscious patient. More attention should be paid to the art of holding a mask firmly and comfortably on the face until consciousness is lost. Light shining in a patient's face may seem a small thing but it can be so distressing that it is a favorite torture method.

Children between the ages of two and ten years present a real problem. Under two years of age we have already indicated that the memory of painful and unpleasant experience is for the most part non-existent. Once past this age, the child may retain the experience of suffocation under an ether mask into adult life. This is the basis for much of the fear of anesthesia on the part of some adult patients. To properly manage the psychological problems leading up to the induction of anesthesia in a child is one of the most difficult problems that we face. If time permits, it is possible to become well enough acquainted with the child so that he will allow you to perform the necessary events of induction without trauma or restraint. More frequently we see the child delivered to the operating room by tearful parents whose own anxiety is quickly transferred to the baby. Even with the most skillful management and the utilization of all approaches, about 30% of children carry with them an unpleasant memory in association with anesthesia. For this reason the technics involving administration of rectal barbiturates in the patient's room are gaining swiftly in popularity. So far it has proven to be a safe and adequate answer to this problem in children under sixty pounds in weight. These children have no recollection whatsoever of the events leading up to the induction and thus carry with them no phobias regarding anesthesia. The older children can be well enough premedicated so that they accept venipuncture or the proper application of a face mask without any more difficulty than that experienced with adult patients. I do not intend to underplay the importance of proper "psychology" in the management of pediatric cases, but I do feel that the answer to this problem lies more in the proper use of drugs than in the application of psychology.

Another area of neglect lies in the field of geriatrics. Because of an increasing life span, more and more elderly patients present themselves for anesthesia and surgery. It is often said that by the time old age is reached the person has learned to accept such things with a calm, philosophical attitude and consequently does not require the degrees of attention given to younger patients. All of us have seen patients whose first admission to a hospital came at the age of sixty or seventy. These individuals should receive the same degree of consideration and solicitude given to younger people. Consideration should be given to the fact that they do not see as well, or hear as well, or understand as quickly as the younger, more alert, patient. Too often their failure to cooperate stems from a failure to comprehend what you are trying to achieve. A little time consumed in explanation produces a much happier patient than the physical

restraint by one or two strong orderlies. In this group of patients particularly it is sometimes fatal to allow them to become depressed, for much of their battle stems from a desire to return to active family life. Should they be prompted to give up by a seeming lack of consideration by those involved with their treatment, it is difficult to encourage them to make the effort necessary to get back on their feet.

Summary

1. Remember that most patients have only one experience with anesthesia.
2. A pre-operative visit, properly performed, can have a much more sedative effect than many drugs.
3. The operating room should be a congenial, quiet, efficient place without loss of appreciation of the patient's natural fears.
4. A few words in advance of any strange sensation will produce a cooperative and tranquil patient.
5. Children and the aged should receive special attention because of the problems peculiar to their age groups. Children are best handled by the proper use of drugs, the aged by the proper use of words.
6. The growth of anesthesia has been in great measure due to the proper employment of the "Art of Anesthesia". Technics, drugs, and newer concepts should not neglect this important factor.

Succinylcholine Chloride
A Short-Acting Curarising Agent

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Pharmacologic research on drugs with curare-like properties was carried out under the direction of Dr. D. Bouvet first at the Pasteur Institute in Paris and then at the Institute Superiore di-Sanita. Dr. D. Bouvet and colleagues have synthesized many curarising agents which they had the opportunity of testing clinically at the Institute of Surgical Pathology of the University of Rome. Among those products tachycuraryl has proved of particular clinical interest because of its good curarising action and its extremely short-lasting effect of only two or three minutes. This, then, differentiates it from the other medium-acting or the slow-acting relaxants.

Chemistry

Succinylcholine chloride is also known as diacetylcholine chloride for it is actually two molecules of acetylcholine chloride linked together at the alpha methyl groups.

Succinylcholine is hydrolyzed rapidly in alkaline solution and also by the pseudo-cholinesterase of the plasma. The products of hydrolysis are succinic acid and two molecules of choline; both succinic acid and the choline being normally-occurring metabolites.

Succinylcholine chloride is a white crystalline solid. It dissolves readily in water, forming a slightly acid solution. The acid solution is relatively stable and it may be sterilized by autoclaving. On the evidence of biological assay, solutions may be kept as long as three months at room temperature without substantial loss of potency. However, after long standing there is a gradual loss of potency and, therefore refrigeration is recommended. Sterile dilute solutions of succinylcholine may be kept at room temperature for several days; they lose approximately 2% of their potency in two weeks when so stored. Solutions are rapidly hydrolyzed when mixed with any alkali, including sodium barbiturate derivatives.

Pharmacology

Succinylcholine is classified with the depolarizing muscle relaxants, having just one charge—a negative or a positive. Its action at the myoneural junction re-

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sembles that of acetylcholine. Its first effect is a transient stimulation of some groups of muscle fibers, but this stimulation rapidly gives place to flaccid paralysis resulting from the blockade of the myoneural conduction. In clinical doses, it does not block transmission at the autonomic ganglia nor at the end organs.

Initial stimulation of some muscle fibers resulting from administration of succinylcholine is occasionally apparent although the drug is injected slowly. Muscle twitchings are more commonly seen if the drug is given rapidly. As the twitchings subside flaccid paralysis develops. The muscles of the eyelids are first affected, then those of the jaw, neck, extremities, abdomen, intercostal region and diaphragm, in that order. Recovery from "just-paralyzing" doses begins in about two minutes and is usually complete in four to six minutes; recovery of muscle strength is in an order opposite to that of the paralysis; that is, the diaphragm and intercostal muscles recover first.

For prolonged effect succinylcholine is given by continuous drip of intravenous infusion. The level of paralysis can be controlled to any predetermined level by altering the rate of flow.

Intravenous Infusions: Dosage

The aim during long procedures is to give sufficient succinylcholine to produce good relaxation without respiratory arrest. This goal can be best achieved by continuous intravenous administration of the drug. With this method of administration the controllability of succinylcholine is such that a predetermined level of muscle paralysis can be maintained for several hours.

Succinylcholine, in 5% glucose solution or in sterile isotonic saline solution, is given by intravenous drip. The strength favored by most anesthetists is 0.1%; that is, 500 mg. succinylcholine chloride in 500 cc. solution. The desired degree of relaxation is usually achieved by allowing solution of this strength to flow at about 2 cc. to 4 cc. (2 mg. to 4 mg.) per minute, (average 2.5 cc. or 2.5 mg.). There is considerable variation from patient to patient and the amount required may be as little as 0.5 cc. (0.5 mg.) or as much as 10 cc. (10 mg.) per minute. However, if it is desirable to restrict fluids because of heart failure, or other pathological conditions, a 0.2% solution may be used; that is, 500 mg. succinylcholine chloride in 250 cc. solution. The rate of flow of this solution will generally be found to be 1 cc. to 2 cc. per minute. The degree of muscle relaxation can be changed within thirty to sixty seconds by altering the rate of flow of succinylcholine.

After discontinuing the administration of succinylcholine muscle tone returns within two to six minutes; in other words, just as promptly as after a single injection of the drug. This prompt recovery is advantageous at the end of the operation.

Mechanism of Action

The exact mechanism of the action of succinylcholine has not yet been elucidated fully, though all evidence points to some interaction between the chemical and the cholinesterases. It seems probable that succinylcholine

exerts its effect by occupying receptor sites of voluntary muscles which are normally occupied by the acetylcholine produced in response to nerve impulse. Whereas acetylcholine is almost instantaneously destroyed by the true cholinesterases of the tissue, succinylcholine is little affected by this enzyme; therefore, it probably remains in the vicinity of the end-plate for several minutes, causing persistent depolarization, evidenced by muscle flaccidity.

The effect of anticholinesterase drugs on succinylcholine activity is a signifcant phenomenon. Cholinesterase inhibitors such as Prostigmine (neostigmine) and Physostigmine (eserine) prolong the effect of succinylcholine, by preventing the enzyme from hydrolyzing the drug. For this reason, it is important never to give Prostigmine or any other anticholinesterase to a patient who has just received, or is about to receive, succinylcholine.

Compatability With Other Relaxants

The neuromuscular blocking effect of succinylcholine is not influenced by previous doses of other relaxants, provided recovery from their effects has taken place; similarly, any relaxant may be given after the return of muscle tone following succinylcholine administration. On theoretical grounds succinylcholine would be expected to be inhibited if given while d-tubocurarine or gallamine (flaxedil) is still acting, since these drugs block depolarizing action. Similarly, the action of d-tubocurarine should be inhibited by succinylcholine. But because decamethonium also acts by depolarization, the effects of succinylcholine and decamethonium administered together would be additive. Generally, in practice, the effect of succinylcholine does not appear to be greatly influenced by previous administration of other relaxants, provided it is not given immediately after another. If prostigmine or other anticholinesterase is given to counteract the effect of d-tubocurarine or gallamine, the effects of succinylcholine given subsequently are greatly prolonged. Clinically, care must be taken never to give succinylcholine in these circumstances. Procaine and Edrophonium (tensilon), given intravenously, also tend to intensify the action of succinylcholine.

Effect on Circulation

No significant effect on blood pressure is caused by intravenous administration of succinylcholine, in "just-paralyzing" doses. If doses large enough to produce respiratory arrest are given, typical asphyxial pressor response appears.

Effect on Respiratory Center

Paralysis of respiration is an integral part of the effect of larger doses of succinylcholine. The ratio between the dose which just paralyzes skeletal muscles but allows spontaneous diaphragmatic breathing, and the dose required just to abolish respiration, is generally about 1 to 2. This abolition of respiration is a result of the neuromuscular blockade of the intercostal muscles and the diaphragm.

Episodes of delayed recovery of respiration have been noted in a

few patients. Out of 546 patients given the drug, Bourne reported 5 in whom delay in return of respiration was longer than 8 minutes; Evans reported that in 2 out of 400 patients recovery took 20 minutes. The recovery time of the remainder was 2 to 4 minutes. On the other hand, Foldes, who advocates smaller doses, states that in a series of 500 cases ". .respiratory depression, seen in 12 to 25% after the use of other muscle relaxants, was not observed in any of the patients after the use of succinylcholine." Whether the depression is due directly to the drug, or whether it is due to hypersensitivity of the respiratory centers of some individuals to the acapnia often produced by too active artificial respiratory assistance, it is less often induced by succinylcholine than by other relaxant drugs.

Clinical Indications

Succinylcholine chloride, as any other muscle relaxant, should be used only by those skilled in the technic of controlled respiration. It is not an analgesic nor an anesthetic agent; therefore, it should be used only in conjunction with general anesthesia when employed during surgical procedures. Succinylcholine chloride is suitable for practically all procedures including the majority of surgical operations or manipulations, whether of long or short duration. Succinylcholine is a particularly suitable muscle relaxant for debilitated, dehydrated, and aged patients. Because of its ultra-short action, succinylcholine is especially suitable for eliminating or modifying the convulsions of electro-shock therapy.

Succinylcholine has given excellent results, by producing complete relaxation at the crucial moment, coupled with rapid recovery in the following procedures:

Endotracheal intubation, direct laryngoscopy, bronchoscopy, and esophagoscopy.
Respiratory emergencies such as laryngospasm
Abdominal closure
Hemorrhoidectomy
Tonsillectomy
with endotracheal intubation
Dental operations
with endotracheal intubation
Manipulation or reduction of fracture or dislocation
Electro-shock therapy
Prepartal cephalic version

For all the above the momentary relaxation of a single injection may suffice, or, if preferred, continuous intravenous infusion may be used.

Continuous Administration

Indications for longer administration of succinylcholine cover the whole range of surgery. The virtual absence of toxicity of the drug, its lack of interference with physiological processes (other than neuromuscular transmission), and its very rapid hydrolysis into metabolites normally present make it safe for almost unlimited periods. "Another advantage of succinylcholine is its relative sparing effect on respiration. With comparable muscular relaxation, there is definitely less diminution of respiratory depth, and the respiratory movements are smooth, in contrast to the jerky respiration frequently seen with other muscle relaxants."

Caution During Labor

In obstetrics succinylcholine appears to be useful for facilitating prepartal cephalic version. Caution is necessary concerning its use during parturition. Experience here has not yet been extensive, but there is evidence that succinylcholine passes the placental barrier. Excellent perineal relaxation has been obtained with small doses of succinylcholine, sufficient to allow the performance of difficult manipulation with minimal trauma to the mother, but in a few instances the infant has been flaccid and apneic upon delivery. Recovery of these infants has been rapid and spontaneous respiration commenced by the time the cord was cut. More experience must be gained before any recommendations can be made for employing succinylcholine during labor.

Succinylcholine chloride inhibits neuromuscular transmission but its mode of action differs from that of curare and other curare like drugs. These latter preparations such as intocostrin, d-tubocurarine chloride, flaxedil, and mytolon etc. interrupt transmission of nerve impulses by inhibiting the physiological depolarizing action of acetylcholine, or, in other words, the mechanism is a blocking or neutralization of the acetylcholine reaction. The post-junctional membrane remains polarized and thus no electrical impulse can pass from the nerve to the muscle fiber.

Succinylcholine chloride and compounds such as syncurine interrupt transmission of impulses by causing persistent depolarization of the post-junctional membrane. Thus the neuromuscular unit is unable to return to the normal resting state. In other words, these compounds cause a neuromuscular block by exerting a depolarizing effect on the muscle fibers. The post-junctional membrane remains depolarized.

The duration of the blocking action induced by succinylcholine chloride can be prolonged by prostigmine and other anticholinesterase drugs. Succinylcholine chloride is hydrolyzed by both the plasma cholinesterase and the acetylcholine esterase into harmless natural metabolites, succinylic acid and choline. This double enzymic hydrolysis assures brief duration of action with a single intravenous dose of this agent.

Technics of Administration

A. Intermittent Injection Technic

Patients adequately premedicated with barbiturates, scopolamine and demerol are carried to the first or second stage of anesthesia by the intravenous administration of a 2 1/2% solution of Pentothal Sodium. The amount of intravenous anesthetic agent required to attain this depth of anesthesia varies with age, sex, build, reflex activity, etc. Following the induction of anesthesia succinylcholine chloride is administered by intravenous injection. The amount of this muscle relaxant required also varies; as a general rule, 30-40 mg. is sufficient in the average adult; 50-60 mg. may be required in the robust male; while 20-30 mg. will suffice in debilitated, senile adults. Twenty mg. is also usually adequate in children under 10 years of age.

Fifteen to thirty seconds after the completion of the injection of succinylcholine chloride the vocal cords are visualized by direct laryngoscopy and an endotrachael tube, previously lubricated with a local anesthetic agent is gently inserted into the trachea. The pre-determined gaseous anesthetic agents and/or oxygen are then administered through an intratracheal assembly or by face mask.

Apnea is frequently induced following the administration of the Pentothal Sodium and succinylcholine chloride; thus it is advisable to apply a face mask and perform artificial ventilation with oxygen for thirty to sixty seconds before inserting the intratracheal tube. This increases the pulmonary oxygen reserve and also permits time for the agents administered to exert their maximum effect. It is not necessary to spray the larynx with a local anesthetic previous to intubating the larynx as the vocal cords are usually relaxed and/or abducted.

B. Continuous Intravenous Injection Technic

The patients are anesthetized in the same manner described above. Following laryngeal intubation a continuous intravenous drip of a 0.10-0.20% solution of succinylcholine chloride in normal saline is connected to the infusion set. The required degree of muscular relaxation is obtained by regulation of the rate of flow of the succinylcholine chloride solution. This rate varies markedly, but as a general rule, 30-60 drops per minute results in adequate muscular relaxation without marked respiratory depression.

A relaxant dose of succinylcholine chloride is rapidly hydrolyzed; thus it is possible to provide variable degrees of muscular relaxation depending upon the surgical requirements at the particular moment. For example, during intra-abdominal procedures a rapid infusion rate is necessary during the opening of the peritoneum and the exploration of the abdominal cavity; a slower rate frequently suffices during the operative procedure after abdominal packs and retractors have been correctly placed; and a more rapid rate is required during closure of the peritoneum and the muscular layers. Obviously general anesthesia need only be maintained at a very light level when the above technics are employed.

Fasciculations

The rapid intravenous injection of 20-60 mg. of succinylcholine chloride frequently induces generalized fibrillary muscle twitchings previous to the onset of peripheral muscular paralysis. These fasciculations, which consist of diffuse uncoordinated contractions of various muscle bundles or groups, are caused by a depolarization of the post-junctional membrane of the neuromuscular unit which was referred to previously.

Muscular Relaxation

Clinically the muscles are affected and/or paralyzed in the same order and manner by succinylcholine chloride as by other curare preparations. The muscles innervated by the cranial nerves

being affected first, then the peripheral muscles, the intercostal muscles and finally those of the diaphragm. The muscular relaxation or paralysis induced with succinylcholine chloride, however, appears more marked or intense in character than that induced by the other curare preparations.

Systemic Effects

Publications all stress the low toxicity of succinylcholine chloride in clinical anesthesia as well as in the laboratory animal. It has no appreciable or significant effects on the blood pressure, heart rhythm or pulse, other than a slight increase in rate, even after many times the paralyzing dose has been administered, providing adequate oxygenation is maintained throughout the apneic period. No allergic manifestations are encountered.

The effect of succinylcholine chloride on the respiratory activity of an individual varies directly with the dose administered, as is the case with other muscle relaxants. As a general rule the rate of respiration is increased while the depth is decreased. The incidence of post-anesthetic respiratory depression has been much lower than that encountered when other currently popular muscle relaxants were used. Similarly, with comparable muscular relaxation, there is less depression of tidal volume than commonly encountered with other muscular relaxant agents.

Discussion

There are a large number of muscle relaxant agents being used in anesthesia today. We do not wish to imply that we believe succinylcholine chloride should be the relaxant agent of choice in all instances even though that conclusion would almost seem justified by the excellent results obtained. To distinguish differences among these agents we believe it is worthwhile to review briefly the pharmacologic action, as well as the duration of action, of some of the modern muscle relaxants.

It is noted that intocostrin, d-tubocurarine, flaxedil and mytolon all exert their effect by causing an inhibition of the depolarizing effect of acetylcholine. This results in a flaccid paralysis of skeletal muscles. Syncurine and succinylcholine compounds cause a persistent depolarization. D-tubocurarine also inhibits ganglionic transmission of the autonomic nervous system. Syncurine and succinylcholine have no effect on the autonomic nervous system. Flaxedil inhibits the cardiac vagus causing a tachycardia.

The chief disadvantage of the naturally occurring preparations such as intocostrin, d-tubocurarine, etc. is the fact that they may cause a release of histamine within the patients' tissues and thus can cause bronchospasm, laryngospasm, urticaria, increased salivation and fall in blood pressure, etc. This histamine release does not occur with the synthetically prepared agents such as flaxedil, mytolon, syncurine and the succinylcholine compounds.

Potentiation By Ether

Ether has a curare-like action. Agents such as d-tubocurarine, and intocostrin are markedly potentiated by ether; flaxedil is

moderately potentiated; mytolon is only slightly potentiated; while syncurine and the succinylcholine chloride compounds are not potentiated by ether. When these facts are clinically applied the following becomes readily apparent:

1. The naturally occurring muscle relaxant agents such as intocostrin and d-tubocurarine, are potentially dangerous because of their histamine release effect and should certainly never be administered to asthmatics or patients suffering from any other allergic conditions.
2. D-tubocurarine chloride is indicated when ganglionic block is desirable.
3. Flaxedil is probably contraindicated in circulatory and heart diseases especially in patients suffering from various forms of tachycardia.
4. Caution must be used when using intocostrin or d-tubocurarine during ether anesthesia. This is also true to a lesser extent of flaxedil and mytolon. Syncurine and the succinylcholine compounds, on the other hand, should be perfectly safe to use during ether anesthesia.

Disadvantages

No actual disadvantages are apparent, but the fact that vigilance and careful attention must be paid to the administration of this relaxant because of its potency and rapid hydrolysis might be considered by some to be disadvantageous.

Summary

1. The chemistry and the pharmacology of succinylcholine chloride, the new depolarizing muscular relaxant agent is briefly outlined.

2. The following technics of administration are described in detail (a) intermittent injection (b) continuous intravenous injection.

3. Succinylcholine chloride was found to be particularly advantageous in the following circumstances: respiratory emergencies, endoscopic procedures, laryngeal intubation previous to general anesthesia and manipulation procedures.

4. The chief advantages are (a) Rapid production of muscular relaxation which can be accurately controlled. (b) A wide safety margin and (c) Absence of undesirable systemic effects or neurological sequelae.

Anesthetic Emergencies

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There are two gases whose importance cannot be over-emphasized—one is oxygen and the other, carbon dioxide. Oxygen is essential to life, but carbon dioxide is a poison which the body must eliminate. Many emergencies during anesthesia are mainly due to either oxygen want or to the accumulation of too much carbon dioxide. Unless a patient is anemic it is usually easy to tell when he is not getting a sufficient amount of oxygen. Our greatest trouble results from an inability to recognize when carbon dioxide has reached dangerous concentrations.

Carbon Dioxide Accumulation

It has been shown, experimentally, that in a closed system using 100% oxygen, an animal can remain pink, with no respiratory movements, for several hours. This is due to the fact that the blood passing through the capillaries of the lung alveoli will pick up oxygen and cause more oxygen to be sucked into the alveoli from the closed system. However, no carbon dioxide is being removed, and this eventually will cause the death of the patient or animal. Carbon dioxide cannot be removed unless there is adequate ventilation and good soda lime absorption. Rapid, shallow respiration does not remove carbon dioxide. In all these conditions, the patient remains pink, but his actual condition is not good.

It has been demonstrated on clinical patients under general and high spinal anesthesias, to whom no respiratory assistance has been given, that carbon dioxide continues to build up in the body. Respiration must be aided by manually squeezing the bag each time the patient inhales, in order to assure competent movement of the gases from the lung to the soda lime and back. It must be remembered that soda lime becomes less effective the longer it is used. Fresh soda lime is efficient for about an hour at a time. Certainly, six hours is the longest period that any soda lime canister can be safely trusted.

In only a very few cases of anesthesia for abdominal surgery can respiration be adequate without assistance. Patients who have had heavy pre-medication or who have had pentothal, which itself is a respiratory depressant, need aided respiration. Major abdominal and open chest cases should

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be carefully watched and respiration aided at all times. This is true, regardless of the anesthetic agents administered. In general anesthesia, we are now achieving relaxation through the use of muscle-relaxant drugs. We must remember that no matter what the salesmen claim, these drugs do affect the muscles of respiration even without anesthesia. Relaxation adequate for abdominal surgery is itself enough to depress respiration.

At times, when changing from old to fresh soda lime, a patient may develop irregularities of the heart rate and rhythm. Experimentally, this has been shown to occur every time carbon dioxide is allowed to build up to a high level and then suddenly is reduced. This may be one of the pre-disposing factors to cardiac arrest, especially when the arrest occurs toward the end of an operation. Changing the soda lime frequently and flushing out the system with a fresh anesthetic mixture will keep the carbon dioxide level nearer normal. A rise in blood pressure during the course of an anesthetic is usually the first sign of excess carbon dioxide. The next sign is increasing depth and rate of respiration. If the anesthesia is deep, these signs are absent. It is the result of this same process that a patient will have a good blood pressure at the end of surgery, but by the time he is returned to his room, the blood pressure has fallen to a very low level.

These patients re-adjust and recover slowly after an hour or more. The best preventive treatment is to flush out the mixture frequently during the latter part of the operation. Also, be sure that carbon dioxide absorption is efficient so that the carbon dioxide, if it has built up during surgery, can be reduced gradually.

During anesthesia the signs of oxygen want that can be detected are cyanosis, unless the patient has anemia, and the slow, bounding pulse. Some cases develop irregular respiration and then chin-tugging, as the accessory muscles of respiration try to help inhale more oxygen.

Laryngospasm

The most common emergency we encounter in surgery is laryngospasm. It varies in frequency and severity, depending upon the cause. Stimulation during light anesthesia is relieved usually by deepening the anesthetic. Foreign material in the pharynx frequently causes laryngospasm. This spasm is usually never completely relieved until the offending material is removed or very deep anesthesia is established. The foreign material may be a flake of tobacco, mucus from the naso-pharynx, chewing gum, gastric regurgitation, or vomitus. It can usually be removed by suction. It must be remembered that pentothal and other barbiturates in themselves aggravate the pharyngeal reflexes and thus help to promote the occurrence of laryngospasm. Strong visceral stimuli from manipulation of some visceral organs will produce laryngospasm. Deepening the anesthesia or infiltration of the area of operation with procaine solution usually relieves the spasm.

Irritant anesthetic gases may produce spasm. Danger from this

factor can be eliminated by diluting the mixture with air or oxygen and starting over with a more dilute mixture and a slower rate of increase in concentration as the patient becomes accustomed to it. If laryngospasm persists for several minutes flush out the system, fill the bag with oxygen, and create a gentle pressure by squeezing it. As a resident, I was taught that all patients will relax before they die, and holding pressure with oxygen will force it into the lungs as soon as the patient begins to relax. The purple color becomes more pink and the slow pulse begins to quicken. After a few breaths, the patient is able to have the procedure continued. Every precaution should be taken to prevent recurrence of this situation.

One agent I have found to be helpful in breaking laryngospasm is succinylcholine, 1 to 1 1/2 cc. doses; that is, 20 to 30 mgs. intravenously. Be sure to breathe for the patient when it is used. Continue artificial respiration and aid respiration until the patient is breathing well on his own. Always remember that, if you have been forced to use pressure to break a laryngospasm or to help a patient to breathe when there is some obstruction, there is probably a gastric dilatation due to forcing a quantity of gas into the stomach. Insert a stomach tube immediately. Usually the respiration and pulse are improved promptly.

Air Swallowing

Apprehensive patients swallow a lot of air and come to surgery with a distended stomach due to pylorospasm. They usually have a difficult induction, the pulse is slow and respiration is irregular. Here a stomach tube is a must. In many instances, a case doesn't progress smoothly until, unexpectedly, the patient belches or vomits up a lot of air, and from then on does very well. All infants for Ramstedt's operation or pyloroplasty require gastric lavage and that the tube be left in the stomach before induction.

Bronchospasm

Bronchospasm is an infrequent, but sometimes difficult, complication to handle. The whole chest becomes tight and fixed. It is almost impossible to get any chest expansion. When this occurs, stop the agents (usually pentothal or cyclopropane), flush out the system, and then force in some oxygen. Gradually change to nitrous oxide with oxygen and ether if necessary. D-tubocurarine and curare have produced bronchospasm a few times, but I have never seen it occur with the use of succinylcholine. Antihistamines intravenously or atropine gr. 1/150 or gr. 1/100 intravenously may help to relieve this condition.

Vomiting

Respiratory obstruction caused by vomiting on the table during or immediately following emergency surgery accounts for too many deaths every year. Delay of operation 12 to 24 hours, whenever possible, is recommended. Even this is not long enough. I recently had a patient who had

eaten a big meal 30 minutes before an accident in which both legs and one arm were broken. The operation was delayed 24 hours and still the patient vomited, once during induction and three times immediately post-operatively. So time alone is not always enough. Always have suction available and working, and the necessary equipment for immediate intubation if needed.

Respiratory Arrest

Respiratory arrest, or apnea, is seen more frequently since newer faster drugs have replaced ether as our main anesthetic agent. Patients stop breathing because of depression of the respiratory center caused by the drugs given before the anesthetic is started, by anesthetic drugs themselves, or by the two combined. I prefer to give my patients smaller doses of pre-medicating drugs to prevent too great depression during the period of anesthesia. When a patient stops breathing, the easiest, safest, and most efficient method of artificial respiration is manual compression of the breathing bag. But for this, a clear airway is essential. Patients who are over-premedicated will stop breathing when the plane of anesthesia is too light for surgery. These patients may even move when the skin incision is made. Certainly they will not have adequate muscular relaxation, but they will not breathe. The only solution here is to continue breathing for them until the period of depression has passed.

When a patient stops breathing because of deep anesthesia, reduce the anesthesia mixture and give artificial respiration. The patient can be safely handled in apnea as long as efficient oxygenation and carbon dioxide absorption are maintained. Too vigorous artificial respiration or over-inflation of the lungs will prolong the apnea after the respiratory depression has been relieved. Allow the patient to regain his own respiration as soon as he will do so and then assist each respiration.

Among the less common emergencies encountered is massive atelectasis. This is the result of bronchial obstruction. A long intratracheal tube entering a main bronchus so that only one lung is aerated, or a mass of vomitus or other foreign material producing obstruction will cause massive atelectasis. Diagnosis depends on recognition of the fact that only one side of the chest expands on inspiration and it may be difficult to keep the patient pink. After inserting an intratracheal tube, make certain that both sides of the chest expand equally. If the bronchial obstruction is due to too long an intratracheal tube, pull the tube back until both sides of the chest expand. Tape the tube in place so it cannot slip back again. When obstruction is due to vomitus or mucus, suction can be accomplished with a long rubber catheter that has openings for suction of big pieces. It is sometimes necessary to call in a bronchoscopist for adequate removal of obstruction material.

Circulatory Complications

In anesthesia, circulatory emergencies occur which require prompt and careful attention. Arrhythmias which are most com-

mon under cyclopropane anesthesia are relieved by reducing the concentration of cyclopropane. But, as I mentioned previously, changes from higher to lower concentrations of carbon dioxide may also lead to arrhythmias. Dumping out the anesthetic mixture in the bag and filling it with oxygen will usually clear up this condition.

Sudden sharp falls in blood pressure require prompt attention. The treatment depends on the cause. In spinal anesthesia a pre-anesthetic dose of vasopressor drug, such as ephedrine or vasoxyl, usually prevents or minimizes the fall of blood pressure. If a blood pressure fall still occurs, give 5 mgs. of ephedrine intravenously or 2 mgs. of vasoxyl; also give intravenous fluids, and always give oxygen.

If the fall is due to sudden blood loss, give blood. If blood is not available or while waiting for blood typing, give plasma or a plasma expander. Blood can be given under pressure if necessary. The simplest method is to attach the blood pressure bulb to a short length of tubing, attach it to the airway opening, and force the blood in by air pressure. You must take great care not to force air into the veins when all the blood has run in.

Sudden blood pressure fall can also occur from pressure on the vena cava, so that there is interference with the return of blood to the heart. Packs, retractors, or bending the patient sharply on a lift can produce this. If this condition is suspected, the surgeon should be told so that he can check and relieve the pressure.

The most dreaded emergency that a surgeon or anesthetist faces is cardiac arrest. Every time the heart stops during the course of surgery and anesthesia, it is called cardiac arrest; but in many instances, the heart stops due to cardiac failure and not true arrest. True cardiac arrest is that catastrophe that occurs to a healthy individual for no apparent reason, but due to some sudden inciting factor. Cardiac failure, on the other hand, is that condition in which the patient is in poor physical condition with perhaps a previously damaged heart, and, under the stress and strain of surgery and anesthesia, the heart fails.

The best treatment for cardiac arrest is prevention first, or prompt treatment when it does occur. When you announce that the heart has stopped, everyone is stunned. Prompt action is imperative. Note the time and have someone write it down. Immediately flush out the bag with oxygen and start artificial respiration. If there is a clear airway, do not take time to insert an intratracheal tube. Be sure to use fresh soda lime in your canister and change the oxygen in the bag often. Have the patient in slight Trendelenburg position. Three minutes is the accepted maximum time that can elapse before good cardiac function is re-established, if brain damage is to be prevented. The most important thing is to start cardiac massage as soon as possible, for this is the only way to get blood and the much needed oxygen to the brain and other vital centers. Procaine hydrochloride in a 1% solution can be given intra-cardially or intravenously and adren-

alin has been used in the same manner. But nothing takes the place of prompt and adequate cardiac massage, for this will re-establish the circulation. If the heart has not been previously damaged, it usually will start beating within a short time after cardiac massage is started. Respiration may lag a considerable period of time after the heart beat is good. Artificial respiration with carbon dioxide absorption must be maintained until the patient re-establishes his own adequate respiration.

Pulmonary embolus is a rare complication that may be seen when a twisted ovarian cyst or a large volvulus is straightened. It might also occur in manipulating an extremity with a thrombophlebitis. Severe bronchospasm occurs and unless recognized and treated immediately by a stellate block, it is fatal. I have heard of one case and it was fatal.

Coronary occlusion and cerebral thrombosis may occur during or following periods of hypotension. The treatment of low blood pressure depends upon its cause.

Fires and Explosions

Last, but not the least to be mentioned, are fires and explosions. Prevention is the only dependable and safe treatment. Here, in most instances, not only the patient, but the anesthetist and sometimes the surgeon as well may sustain injury or burns. Care and common sense in observing hospital regulations to prevent static electricity and in using electro-surgical equipment are always necessary. A simple method of grounding a patient and anesthetist is to use three wet towels; one from the patient to the table, a second from table leg to floor, and a third from the gas machine to the floor. The anesthetist keeps one foot on the floor towels at all times and should be wearing either conductive rubber-grounded or leather-soled shoes.

Conclusion

In conclusion let me say that everyone knows the need for adequate oxygenation at all times during anesthesia. The elimination of excess carbon dioxide has not been stressed as much, but is as injurious to the patient as lack of oxygen. The elimination of carbon dioxide from the closed system is best accomplished by fresh soda lime and adequate pulmonary ventilation, either by the patient alone or with the aid of the anesthetist.

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Anesthesia in Disorders of the Endocrine System

A Review of the Literature

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Introduction

The endocrine system has long been a mystery to the scientist. Recent discoveries of hormones and better understanding of the system as a whole have solved a portion of this puzzle.

Disorders of metabolism, upsets in physiologic balance and actual structural body changes may afflict individuals suffering from endocrine imbalance. Not all endocrine disorders respond to surgical treatment. However, some are treated surgically and these patients may also suffer from other diseases requiring surgical intervention. Therefore, their cases often present problems in anesthetic management.

The following paper is a review of some of the literature dealing with anesthetic management in disorders of the endocrine system.

The endocrine or ductless glands are structures which produce substances called hormones. These hormones pass into the blood stream and are conveyed to various organs and tissues where they perform a variety of actions. Most important to the subject of this paper are their effects on rate of body metabolism and electrolyte balance.

Interdependence is one of the features of the endocrine system. If one gland becomes diseased this may be reflected by upsets in function of several others. The pituitary is commonly known as the "master" gland. Its "tropic" hormones influence the adrenals, thyroid, parathyroids and the gonads.

The pituitary gland is found within a small recess in the sphenoid bone of the skull known as the sella turcica. It consists of an anterior and posterior portion. The anterior portion has among its functions the regulation of growth, elevation of blood sugar, regulation of fat metabolism and control of the glands affected by the "tropic" hormones. The functions of the posterior lobe important to anesthesia are the elevation of blood pressure and the antidiuretic factor.[1]

Some of the pituitary hormones have been isolated in relatively pure states. These include the

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1. Hunter, George and Hunter, F.R., College Zoology, W.B. Saunders Company, Philadelphia, 1949, pg. 577.

growth hormone, the thyrotrophic hormone and the adrenocorticotrophic hormone. Crude extracts of the anterior lobe may have diabetogenic, glycotropic, ketogenic and pancreatrophic effects.[2]

There are many disorders of the pituitary gland but ones affecting the course of anesthesia are not often seen. However, pituitrin and pitressin are said to cause "coronary constriction and potentially a resultant myocaridal hypoxia."[3] Cases have been reported in which "pituitrin shock" followed the administration of the drug to the patients under anesthesia.[4]

Hypophysectomy or complete removal of the pituitary gland may become necessary in patients suffering from fulminant "juvenile" diabetes. In the anesthetic management of these patients, it should be remembered that of the six anterior pituitary hormones, ACTH is the one of critical importance. Corticoid hormones must be included in their management as the adrenal cortex is vitally concerned in body response to stress.[5] Other effects of pituitary dysfunction on the course of anesthesia will be discussed later.

The control of growth and basal metabolism has been attributed to the thyroid gland. This gland is found in the neck of man and consists of two lobes which lie on either side of the larynx. The hormone, thyroxine, was one of the first products of the ductless glands to be isolated.

Disorders of the thyroid are usually characterized by either underproduction or overproduction of thyroxine. However, other pathological states of the thyroid do not affect hormone production. Diseases of the thyroid have been divided into four general categories:

1. Those associated with a deficiency of the hormone: hypothyroidism;
2. Those associated with an excess of the hormone: hyperthyroidism;
3. Those with no significant effect on hormone production: nodular adenomatous goiters;
4. Inflammatory conditions of the thyroid: acute and chronic thyroiditis.[6]

The hypothyroid patient presents the picture of cretinism or myxedema. He has a reduced metabolism rate and may have an enlarged heart. Patients with this condition who appear for surgery should be adequately treated with thyroid extract before they are given an anesthetic as they show increased susceptibility to depressant drugs.[7] The colloid or simple goiter produced by iodine deficiency usually does not cause pressure on the trachea and patients do not often appear for surgical removal of this type of goiter.

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2. Best, C.H. and Taylor, N.B., **The Living Body**, Henry Holt Co., New York, 1952, pg. 473.
3. Cann, John E., "Endocrine Physiology in Relation to Anesthesia", **Journal, American Association of Nurse Anesthetists**, Nov., 1953, pg. 275.
4. Parsloe, C.P., Morris, L.E. and Orth, O.S., "The Relationship of Various Anesthetic Agents to the Action of Pituitrin, Pitressin and Pitocin", **Anesthesiology**, Jan., 1950.
5. Anderson, Bruce and Kinsell, Laurance, "Anesthesia and Management During Hypophysectomy for Fulminant "Juvenile" Diabetes, Unpublished (presented at the October meeting of The American Society of Anesthesiologists) 1954.
6. Merck Manual, Merck and Co., Rahway, New Jersey, eighth edition, 1950, pg. 301.
7. Cann, John E., Op. Cit., pg. 276.

Hyperthyroidism which is characterized by "hyperplasia of the thyroid glandular parenchyma, excessive secretion of its hormonal substance, increased rate of metabolism and often by exophthalmos",[8] is a condition which may cause the anesthetist much trouble. Symptoms may include nervousness, weakness, sensitivity to heat, sweating, restlessness, over-activity, weight loss with increased appetite, tremor, palpitation and prominence of the eyes. With the increased metabolic rate, these individuals are very susceptible to oxygen deficiency. The thyroid "crisis" which is an acute exacerbation of these symptoms is manifested by vomiting, diarrhea, dehydration, great increase in heart rate, extreme restlessness, muscular weakness and sometimes delirium and coma.[9] The increased work load thrown on the heart by the high metabolism may result in cardiac hypertrophy and ultimate failure. In the hyperthyroid patient who appears for operation danger signs may be:

1. Failure of pulse rate to become less than 100
2. Auricular fibrillation
3. History of previous heart failure
4. Failure to gain weight under medical treatment
5. Prolonged existence of the disease
6. Vomiting and diarrhea[10]

Patients with severe hyperthyroidism, even though treated, are often very toxic. Therefore a matter of great importance to the anesthetist is the proper preoperative preparation of these individuals. DeCourcy states that important points in this preparation are:

1. Physical rest
2. Mental rest which includes freedom from anxiety and other emotional disturbances and strains
3. Appropriate sedation when required
4. A diet carefully chosen to provide 5000 calories per day
5. The administration of iodine[11]

Iodine reduces the picture of thyrotoxicosis to that of colloid goiter and it usually produces a pronounced fall in the basal metabolic rate. The thiourea and thiouracil drugs also lower the metabolic rate and in recent years have come into common usage in treatment of hyperthyroidism.[12] The toxic thyroid patient is usually upset emotionally. If he is being prepared for operation in addition to treatment by drugs, he should be placed in a quiet, restful atmosphere and protected from fatigue, mental excitement and worries.[13]

The anesthetic management of the hyperthyroid patient is open to some controversy. In the question of premedication, most authorities agree that the patient

8. Merck Manual, Op. Cit., pg. 367.
9. Cann, John E., Op. Cit., pg. 277.
10. Lee, J. Alfred, **A Synopsis of Anesthesia**, Williams and Wilkins Co. Baltimore, 1953, pg. 357.
11. DeCourcy, J.L., "The Aims of Thyroidectomy and Their Achievement: The Need for Close Cooperation Between Surgeon and Anesthetist", **Anesthesia and Analgesia**, May-June, 1943.
12. Cann, J. E., Op. Cit., pg. 276.
13. West, J. P., et al. **Nursing Care of the Surgical Patient**, The MacMillan Co., New York, 1950, pg. 381.

should be well sedated, usually with morphine. Lee states that he uses scopolamine rather than atropine as a drying agent because atropine raises the basal metabolic rate and increases the heart rate.[14] However, Hudon and Beaudoin favor atropine as they feel that scopolamine makes the level of anesthesia with pentothal more difficult to determine.[15] In addition, it has been stated that clinical doses of atropine "stimulate centrally the vagus and the pulse is generally slowed slightly by this action." This would appear to make atropine the better drug for the thyrotoxic patient.[16] Mousel and Coakley endeavor to individualize sedation and if the patient is very nervous after being brought to the operating room, they advise the injection of a 2.5 per cent solution of nembutal intravenously until the patient is quieted. Reference is made by these authors to the "stealing" of the goiter by the use of basal anesthetic agents such as avertin rectally or pentothal given intravenously before the patient is taken to the operating room. However, they feel that combinations of avertin and local anesthesia are not satisfactory and combination of pentothal and local are not safe. Therefore, they advocate general anesthesia.[17]

The choice of agent for thyroidectomy is also a matter of dispute. Nitrous oxide-oxygen, pentothal-nitrous oxide-oxygen, cyclopropane and local drugs all have their advocates.

Some authorities feel that the patient with diffuse colloid goiter or adenomatous goiter without hyperthyroidism is an apt candidate for local anesthesia. The fact is emphasized that an understanding anesthetist should be with these patients and that particular stress should be placed on reassuring the individual when surgical traction on the gland gives the feeling of suffocation.[18]

Amster advocates the use of the cervical plexus block in poor risk patients. He feels that postoperative complications are lessened and that this method carries a minimum amount of danger and a maximum degree of safety. It is stated that the important factor in this technique is the fact that the "injection should always be made as the needle is being withdrawn not as it is being plunged into the tissue." This prevents injection into a blood vessel.[19]

DeCourcy feels that local anesthesia should be avoided due to the psychic factors in the thyrotoxic patient. His choice of anesthesia is nitrous oxide-oxygen. Among his reasons for this choice are rapidity of effect, easy regulation of dosage and promptness of recovery. It it easy to control depth of anesthesia and the agent itself is relatively harmless. The fact that the combination is nonexplosive is also helpful to the surgeon. This agent should only be administered by the able, ex-

14. Lee, J. A., Op. Cit., pg. 357.
15. Hudon, Fernando and Beaudoin, Robert, "Pentothal in Surgery of the Thyroid", **Anesthesia and Analgesia**, July-Aug., 1948, pg. 216.
16. Krantz, John and Carr, C. J., **The Pharmacologic Principles of Medical Practice**, Williams and Wilkins Co., Baltimore, 1951.
17. Mousel, L. H. and Coakley, C. S., "Management of the Patient with Thyroid Disease", Anesthesiology, July 1949.
18. Ibid, pg. 447.
19. Amster, J. L., "Cervical Plexus Block for Thyroidectomy", Anesthesia and Analgesia, Jan.-Feb., 1938, pg. 2.

perienced anesthetist in these cases and proper premedication should be given.[20]

Cyclopropane gained much popularity in the late thirties due to its ease of induction and the high oxygen concentration permitted. However, Lundy has reported three deaths from ventricular fibrillation in patients with severe thyrotoxicosis while using this drug. He feels that cyclopropane offers further insult to a heart already weakened by thyrotoxin.[21] Its effect on the parasympathetics and tendency to stimulate the vagus may cause bradycardia and bronchoconstriction. An increase in myocardial irritability, extra systoles, ventricular tachycardia and fibrillation are dangers the agent may produce in these toxic patients.[22] During the past few years, the drug has lost much of its popularity and is seldom used in these cases today.

Since 1942, pentothal has become increasingly popular as the agent of choice in thyroidectomy. It combines the advantages of ease of induction, low toxicity, little effect on metabolism and peaceful recovery. Nitrous oxide is said to have many of these same advantages but its danger lies in the exposure to anoxia of patients with an already high metabolic rate. Hudon and Beaudoin object to local anesthesia because nervousness of the conscious patient may cause a sympathicoadrenergic discharge in the blood, an elevation of rate of metabolism and may aggravate postoperative sequelae. They also state that the protection offered to the recurrent laryngeal nerve by local anesthesia can be obtained in light pentothal anesthesia if the anesthetist listens closely during inspiration and perceives the stertor produced by the cord as it is immobilized close to the midline. In their technic, oxygen is administered throughout the operation. A 2.5 per cent solution of pentothal is used with rapid induction the rule. Airway is maintained by naso or oropharyngeal methods and intubation is avoided. After the initial skin incision is made, the patient is carried very lightly and for closure nitrous oxide or ethylene may be added.

These authors feel that the success of pentothal in thyroid surgery is due to the fact that hyperthyroidism has an action on the circulatory system antagonistic to that of pentothal. They state:

> Pentothal over long periods of anesthesia paralyzes the peripheral vessels, which can be detected by analyzing the dilation of the arterioles and capillaries. This loss of vascular tone is not irreversible and can easily be improved by administration of oxygen and an analeptic drug. In thyrotoxicosis, however, the filling of the capillaries is rapid as can be easily evidenced by a slight pressure with a finger on the forehead. The sympathetic system being in hyperactivity, the depressive effect of pentothal will not be evident. It would

20. DeCourcy, J. L., Op. Cit., pg. 139.

21. Lahey, F. H., Hurxthal, L. M. and Driscoll, R. E., "Thyrocardiac Disease", **Annals of Surgery**, Oct., 1943, pg. 681.

22. Mousel and Coakley, Op. Cit. pg. 450.

even seem that this effect of the barbiturate is of some advantage.[23]

It is not thought that pentothal per se causes laryngeal spasm but it may have an irritating effect at the level of the capillaries of the alveoli and bronchioles thus sensitizing the cough reflex. Since thyrotoxic patients are at a high state of sympathetic hyperactivity and the control of this reflex is by the parasympathetics, it is less likely to occur in these people. However, at the first sign of spasm, anesthesia is either deepened or lowered, oxygen is increased and an attempt is made to remove the cause. Muscle relaxants may prove of value during these episodes.

Bleeding may be more profuse than with local agents due to the depressant action of the drug on the vasomotor center. Hudon and Beaudoin feel that hypotension is transitory in thyroidectomy with pentothal and that since pentothal does have depressant action, it may relieve the heart of the burden of attempting to maintain high blood pressure and thus reduce the occurrence of thyrotoxic crisis postoperatively.

The question of intubation for these patients presents a problem. The tube offers protection against respiratory obstruction and hypoxia. However, if tubes are not used, postoperative tracheitis and mucous collection is avoided and it is possible to use a lighter plane of anesthesia. Cann states that if an adequate airway can be maintained without intubation, it should be avoided. Lee advocates intubation if the trachea is deviated, if the goiter is retro-sternal, if malignancy is suspected or if there is abnormal function of the cords preoperatively. He advises that the intubation be done before surgery starts and if stridor is present, he recommends topical intubation.[24]

The endocrine control of carbohydrate metabolism is one of the most important functions of the system. Three hormones are concerned with this duty. They are insulin secreted by the islands of Langerhans in the pancreas, adrenalin secreted by the adrenal medulla and the diabetogenic factor secreted by the anterior pituitary.[25] When the islands of Langerhans fail to secrete adequate insulin or the other two hormones are interfered with in some manner, diabetes mellitus may result. This defect in metabolism which results in decreased ability to utilize carbohydrates by oxidation, conversion to fat or storage as glycogen can prove a disturbing factor to the anesthetist.

Until 1921 when insulin was discovered by Banting and Best, operations on the diabetic patient were a hazardous affair. It has been stated that prior to the regulation of the diabetic by insulin, a mortality rate of 40 percent was found in surgical procedures on these people. In 1948, this figure had been reduced to 16 percent.[26]

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23. Hudon, F. and Beaudoin, Robert, Op. Cit., pg. 217.

24. Lee, J. A., Op. Cit., pg. 358.

25. Hunter and Hunter, Op. Cit., pg. 579.

26. Bleeker, P. B., "Diabetes and Anesthesia", **Journal American Association Nurse Anesthetists**, Feb., 1948.

Diabetics now live longer and thus become subject to more diseases requiring surgical intervention. However, the properly controlled diabetic should be in little more danger than the normal individual if an adequate and proper choice of anesthesia is made. In making this decision, close cooperation between anesthetist, surgeon and internist is imperative.

Premedication for the diabetic patient evokes little controversy. The proper dosage for the patient should, of course, be determined.

Most authorities agree that local or regional anesthesia are the techniques of choice in the diabetic. Local, regional spinal, ethylene, cyclopropane, nitrous oxide-oxygen, pentothal and ether are the choices of Bleeker in that order.[27] Leonard lists local procaine alone or in combination with other agents as his first selection followed by barbiturates, spinal, inhalation drugs such as nitrous oxide, cyclopropane, ethylene and ether.[28]

Even in normal individuals inhalation agents cause certain metabolic and systemic effects. Thus the drug used for the diabetic should be one which causes the least disturbance. The agent should have little toxic effect on the liver or kidneys and should not be associated with anoxia. Even the best drug will inhibit the oxidative enzyme system of the brain dealing with glucose and lactic acid. The deeper the plane of anesthesia, the greater inhibition occurs. The acute complications of diabetes that are feared are acidosis, infection and hyperglycemia. In addition to these the danger of hypoglycemia from excessive administration of insulin is present.

Chloroform is said to increase the blood sugar 200 per cent above normal, may be damaging to the liver and has a tendency to produce acidosis. Ether also suppresses glycogen formation in the liver and may increase blood sugar 100 to 200 per cent. The drug may also cause a lowering of glycogen in cardiac muscle and a depression of endogenous insulin formation.[29]

In a prolonged anesthesia with ether, the diabetic may be pushed toward acidosis. The moderate diabetic will probably not be harmed by its administration but in the severe case or in long anesthetics, it should be avoided.

The control of the diabetic preoperatively is usually in the hands of the internist. Elective surgery should never be undertaken unless the patient is properly prepared. Insulin dosage must be regulated and electrolyte balance maintained by diet and parenteral fluids if necessary. Bleeker recommends a 24 hour urine determination, diet adequate to insure proper glycogen reserve and regular insulin in the immediate preoperative period.[30] Lee feels that a diabetic not taking insulin should receive an extra 50 grams of glucose with 10 units of regular insulin for several days preceding

27. Ibid, pg. 36.
28. Leonard, Walter, "Anesthetics in Diabetes", **Anesthesia and Analgesia**, July-Aug., 1936, pg. 191.
29. Bleeker, P. B., Op. Cit., pg. 35.
30. Ibid, pg. 37.

operation. Immediately before surgery, in place of the morning meal, he advises 50 grams of glucose with 25 units of insulin.[31] Other authorities state that the well controlled diabetic should receive one sixth of the previous days total insulin dose and one sixth of the preoperative diet in liquid form at six a.m. on the day of operation. One hour before surgery, 25 grams of glucose 10 per cent is given intravenously in normal saline.[32]

A real anesthetic problem may be presented by the diabetic who appears for emergency surgery. Even though the situation is acute, time should be taken for urine and blood sugar determinations. If possible, a carbon dioxide combining power should be done. An effort should be made to correct electrolyte imbalance and to insure proper insulin and glycogen levels. Lee feels that if ketonuria is present in such patients, 100 grams of glucose in a 10 per cent solution with 100 units of insulin should be given intravenously until the urine is free from diacetic acid. Bleeker however, states that if blood sugar is very high, 20 units of insulin in one liter of 5 per cent glucose in normal saline should be given. The anesthetist should be on the alert to see that these patients, both emergency and elective, are properly prepared. Proper choice of agent and technic, cooperation with surgeon and internist and as always, close observation of the patient are primary factors.

Some interest has been shown of late in the technic of refrigeration anesthesia. It seems to be especially applicable to the patient requiring amputation for diabetic gangrene. These individuals usually are severe diabetics and in addition, may be elderly and debilitated. It is felt that the reduction in metabolism obtained through this technic, the protection against shock, reduction of postoperative pain and inhibition of bacterial growth makes it valuable in the diabetic patient. The major drawback is said to be delay in healing but this is offset by the inhibition of bacterial activity.[33]

The adrenal glands found at the upper poles of the kidneys are a very complex part of the endocrine family. These glands are composed of a cortex and medulla. The cells of these two portions differ greatly in both structure and function. The cortical cells secrete hormones which play important roles in many metabolic functions. They also affect the reproductive system and tumors of the cortex may produce bizarre sexual changes. The medulla is chiefly concerned with the manufacture of adrenalin and tumors of this portion of the gland may present the picture of malignant hypertension.[34]

The medullary hormone, adrenalin, is an almost perfect imitator of the effects obtained from stimulation of the sympathetic nervous system. Administration of adrenalin produces an effect lasting only one or two minutes. In clinical doses, it causes "constriction of the arterioles and capillaries of the skin, mucous membranes, and splanchnic viscera and dilation of the vessels of

31. Lee, J. A., Op. Cit., pg. 372.
32. Merck Manual, Op. Cit., pg. 279.
33. Bleeker, P. B., Op. Cit., pg. 38.
34. West, et al., Op. Cit., pg. 387.

the muscles and of the coronary arteries." The hormone also quickens the heart rate and increases the oxygen consumption of cardiac muscle.[35]

The chief anesthetic problem encountered in disorders of this gland is that presented by the chromaffin tumor of the medulla known as pheochromocytoma. This tumor is described as "a chromaffin cell tumor, usually benign, causing hypertension through the production of excessive amounts of epinephrine."[36] The four main problems in anesthetic management of these individuals are said to be:

1. Adequate muscle relaxation
2. Possibility of pneumothorax occurring from surgical manipulation
3. Effects of excessive secretion of epinephrine
4. The sudden circulatory depression that may occur after excision of the secreting mass.[37]

To solve the first two problems, ether and endotracheal anesthesia are advised. It is best to avoid agents such as cyclopropane, chloroform and ethyl chloride which in the presence of adrenalin may produce severe ventricular arrhythmias. To combat paroxysmal hypertension, a drip of piperoxan hydrochloride (20 mgm) is found effective. The hypotension and circulatory collapse found after the tumor has been removed may be controlled by infusion of a vasopressor such as dilute solution of neosynephrine or norepinephrine. It may be necessary to maintain this drip for several days postoperatively.

The recent discovery of the anti-adrenalin and hypotensive effects of the drug, chlorpromazine, may make it useful in the anesthetic management of pheochromocytoma. Dundee has used the drug in one case as a premedication also just before handling of the tumor. He found that the hypertensive response of the patient was much reduced and that duration of the drug's effect was much longer than that of Regitine.[38]

Thompson and Arrowood feel that the hypotensive crisis is the most damaging to the patient who is being operated for pheochromocytoma. Therefore, they avoid the use of ganglionic blocking agents preoperatively. If it is absolutely necessary to employ one of these drugs, they advise Regitine because of its short duration of action. They also state that selection of agent is less important than an understanding of the physiologic principles underlying the anesthetic management of these patients. These authors maintain that intubation is obligatory and feel that the use of spinal anesthetic is contraindicated as it pre-disposes to circulatory collapse. Cyclopropane should be avoided as it sensitizes the heart to epinephrine. Their choice of anesthesia is a slow induction with pentothal drip 0.3 per cent and then the use of nitrous oxide-oxygen-ether.[39]

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35. Cann, J. E., Op. Cit., pg. 277.
36. Merck Manual, Op. Cit., pg. 394.
37. Cann, J. E., Op. Cit., pg. 277.
38. Dundee, J. W., "A review of Chlorpromazine Hydrochloride", British Journal of Anesthesia, Sept., 1954, pg. 375.
39. Thompson, Jesse and Arrowood, Julia, "Pheochromocytome: Surgical and Anesthetic Management". **Anesthesiology**, Nov., 1954.

In tumors of the cortex, for example, Cushing's Syndrome, surgical removal may precipitate Addisonian crises. Preoperative normal saline should be given and intravenous injection of noradrenalin and cortisone may be required. Occasionally, a patient with Addison's Disease or cortical insufficiency appears for operation. These patients are, of course, very susceptible to Addisonian Crises. If the condition has been diagnosed and proper preoperative treatment given, the danger is lessened. Dextrose, sodium chloride and adrenal cortical extract are advised. Care should be taken to avoid agents or technics which may produce hypotension or anoxia.

Bilateral adrenalectomy may be necessary for malignant hypertension or in carcinoma of the prostate. A preoperative salt free diet, diuretics, digitalis and sedatives are usually prescribed. Cortisone 100 mgm. the night before operation and intravenous injection of whole adrenal cortical extract during surgery are helpful in maintaining proper physiologic balance.[40] Cann feels that there is no specific relation between the production of hypotension in these patients and the agent or technic used. He states that the maintenance of a satisfactory blood pressure is the most useful guide to the administration of adrenal cortical extract.

The advent of cortisone and ACTH therapy has been of great value in the treatment of many diseases. However, individuals who appear for surgery after having received the drug may present a problem to the anesthetist. The chief danger seems to be in the depression of adrenal cortical function which may be unrecognized. If, during surgery, unexplained shock which does not respond to the usual treatment develops, depressed adrenal cortical function may be the answer.[41] This shock may also occur up to 36 hours postoperatively. It is sudden and so extreme that it may be irreversible. Lundy advises preoperative preparation as follows:

1. Intramuscular injection of 100 to 200 mgm. of cortisone per day for two to three days before surgery and on the day of operation;
2. A similar schedule two to three days postoperatively;
3. Gradual reduction of the dose to previous optimal figure.

If a patient who has been receiving the drug appears for emergency surgery, he should be given 30-50 cc. of adreno-cortical extract intravenously. Resumption of cortisone or ACTH must be instituted at once. Cortisone (free alcohol) is also available for intravenous injection.

Surgical trauma, even in the normal individual, may, when combined with anesthesia, produce a breakdown of the hormonal adaption mechanism. The essential endocrine mechanism which functions in time of stress is the pituitary-adrenal response.

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40. Lee, J. A., Op. Cit., pg. 340-341.

41. Lundy, J. S., "Cortisone Problems Involving Anesthesia", Anesthesiology, July, 1953, pg. 376.

The effectiveness of the response is indicated by the number of eosinophiles in circulating blood. It has been stated that general anesthesia may block the normal response of this mechanism in times of stress. A study was done which shows that in some types of general anesthesia, the response of the eosinophiles to surgical trauma is delayed.[42] These facts attain more importance if the patient has added to the strain of anesthesia, depressed adrenal cortical function.

Conclusion

While patients with disorders of the endocrine system constitute only a small portion of individuals appearing for anesthesia, they present some unique problems to the anesthetist. A review has been made of some of the literature dealing with these problems and their solution.

Recognition of the disorder, proper preoperative preparation, astute choice of agent and technic and cooperation with surgeon and internist are primary requisites for good management of these patients. As in all anesthesia, one must remember that "eternal vigilance is the price of safety!"

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Anesthesia in the Korean War

Ju-Duk Yun, M.D. *
Korea

Prior to the invasion by the communists in June, 1950, there were no trained medical anesthesiologists nor were there trained nurse anesthetists in Korea. Anesthesia for the Koreans was either by a local or a spinal anesthetic given by a physician or drop ether given by a nurse. The war made the need for trained anesthesiologists very apparent. Since there were a great many casualties, many with oro-maxillary, thoracic and neurosurgical wounds, surgery was required for removal of the fragments and for repair.

In August, 1952, a friend and I were selected by our superiors to be sent to the United States for 6 months of training in anesthesiology. My friend, a physician also, was assigned to Letterman General Hospital in California; I was assigned to Madigan General Hospital in Tacoma, Washington. For us it was an introduction to totally unfamiliar material and equipment. We received six months of intensive training, made even more difficult for us because the teaching was in English.

We returned to our homeland in March, 1953, and assumed our duties as anesthesiologists. I was assigned to the 1st Republic of Korea Army Hospital where the most serious cases were sent. Since the number of casualties was high, my American-trained friend and I were called upon to administer anesthetics to those patients who had the gravest anesthetic problems. These were, for the most part, patients with oro-maxillary wounds.

In addition:

1. We were responsible for the pre-operative work-up and pre-operative orders concerning our patients.
2. We were responsible for the anesthetics given by other doctors and nurses who were being taught modern anesthetic methods by us.
3. We were responsible for and supervised the corpsmen who were frequently assigned to sit with patients under spinal anesthesia.
4. We supervised the Recovery Section and wrote the post-operative orders.
5. We evaluated and tagged the patients for evacuation to the airport, indicating facts in each case for which the evacuation nurse must be alert.

Read before the 20th Anesthesia Institute at St. John's Hospital, Springfield, Illinois on Nov. 19, 1954.

The problems of an army hospital in the field are many; frequent lack of equipment; failure of equipment; need for improvising equipment and above all, the need for early evacuation of the patients. I might also add that we had to take " a mother's care" of our equipment, all of which was supplied to us by the United States and which was difficult to replace. I would estimate that I gave 1300 anesthetics in the course of the war.

The following incident is one of many which I won't forget: I was asked to give an anesthetic for chest surgery. Because I stopped to see another patient, I was delayed in arriving, so I sent my machine ahead with a corpsman, and sent word to have a doctor, to whom I was teaching modern anesthetic methods, to begin the anesthetic. Shortly thereafter, the corpsman rushed in to tell me that the patient was dead. I hurried over to determine what the cause of the death was and found that in moving the machine and re-attaching the tanks, the corpsman had attached the Nitrous Oxide tank to the Oxygen regulator and the Oxygen tank to the Nitrous Oxide Regulator. The corpsman did not know English and the error was not seen by the doctor. Thus, when the patient became cyanotic, the doctor, believing that he was using 100% Oxygen in his attempt to resuscitate, was actually using 100% Nitrous Oxide. It was my most bitter experience during the war.

Another incident proved that too much blood can be as harmful as too little blood. The patient's right arm and left thigh had been amputated. Shock developed immediately after the amputation, so the surgeon and I ordered 1000 cc. of blood. When the patient's condition did not improve, the nurse gave another 2 pints of blood without consulting the doctor. The patient became more cyanotic. The nurse gave another 2 pints of blood, making a total of 3000 cc. within 5 hours. The patient died.

To anesthetize we used Sodium Pentothal 2% intravenously, and Nitrous Oxide-Oxygen by inhalation. Pentothal was used only for induction, or for minor cases. If additional drugs were needed for maintenance of surgical anesthesia, we supplemented with ether. Almost all patients were intubated. We did not have Curare or any other muscle relaxant because it was difficult to obtain them. Cyclopropane was forbidden us by the army for obvious reasons. Our gas machines were Heidbrink Junior Portables. We used circle type filters, Foregger larnygoscopes, and late tracheal catheters. The ordinary small adult size catheter fitted the average Korean and was occasionally too large because the Korean airway is much smaller than the American. We seldom needed to pack and did not use cuffs on our catheters.

Although my friend and I were the first Korean Army anesthesiologists, we have been joined by 50 of our fellow surgeons, all trained in this specialty and all practicing it today in our homeland. The development of anesthesiology in our country has naturally made possible the suc-

(Continued on page 133)

Legislation

Emanuel Hayt, LLB., Counsel, A.A.N.A.

Injury To Student Nurse Held To Be Subject To Workmen's Compensation Law—The Highland Hospital moved to dismiss the complaint against it on the ground that the Court did not have jurisdiction of the action. The plaintiff, father and administrator of deceased, alleged in the first cause of action of his complaint that the decedent became a student nurse in the employ of the defendant Hospital in September 1950 and continued as such until her death on July 6, 1951, that part of defendant Hospital's agreement with the decedent was that it would supply doctors for any illness that she should incur as a student, that the defendant Hospital negligently assigned the decedent to contagious disease cases, and failed to use due care in its supervision of decedent and in its selection of physicians and instructors it employed and in selecting and supplying equipment used in the practice of nursing, and failed to give proper instruction for sterilizing and preparing instruments used in connection with the treatment of contagious disease.

The court held as follows: "It being undisputed that the decedent was covered by workmen's compensation and, as alleged in the first and fourth causes of action, that decedent was employed as a student nurse at the time of her illness and death and was treated in the course of her employment, plaintiff's exclusive remedy in said causes of action is with the Workmen's Compensation Board.

"The second cause of action stands on a somewhat different footing. Although it is therein alleged that decedent was a student nurse in training with the defendant Hospital, it is not alleged that she was treated in the course of her employment, but it is alleged that she entered the Hospital as a patient for treatment and that through the negligence of defendant Hospital in employing its physicians and nurses and through their negligence in treating decedent, she died.

"The motion herein is directed to the Court's lack of jurisdiction of the subject matter. Clearly, the Court has jurisdiction of this subject matter, assuming that there was no relationship between decedent's employment and her illness and death. But it is equally clear that the above facts do not constitute a valid cause of

action against the defendant Hospital since there is no allegation of administrative negligence on the part of the Hospital. The scant references in the complaint to faulty equipment, made in contest through its physicians and nurses, cannot support a cause of action for administrative negligence on the part of the Hospital.

"Under said defendant's request for other relief, it seems proper, therefore, to rule on this cause of action as a matter of law. Hence all three of said causes of action must be dismissed.

"The plaintiff indicates in his opposing affidavits that he now seeks to stand on a different set of facts from those originally pleaded. An amended complaint may contain a cause of action that is not subject to the motion made herein. The motion is therefore granted in favor of the defendant Hospital with leave to the plaintiff to serve an amended complaint within twenty days of the service of a copy of the order to be entered hereon with notice of entry."

(Glaser v. Highland Hospital, 131 N.Y.S. 2d 728)

Court Holds Administrator Not Required to Produce Abortion Records For Grand Jury.— The district attorney moved for an order adjudging Dr. I. Magelaner, the superintendent of the Kings County Hospital, guilty of a criminal contempt of court, for his refusal to comply with and disobedience of a subpoena duces tecum duly issued and served upon him by the grand jury to produce "all papers, folders, charts and hospital records of any and all persons treated at the Kings County Hospital for 'Abortion or Miscarriage' (other than therapeutic) complete and incomplete, for the period beginning June 1, 1952 to and including August 31, 1952, and the further period beginning June 1, 1953, to and including August 31, 1953, and all other deeds, evidences, and writings which you have in your custody or power concerning the premises."

On the return day of the subpoena, April 12, 1954, Dr. I. Magelaner, Superintendent of Kings County Hospital, personally appeared before the grand jury and upon the advice of the Corporation Counsel of the City of New York respectfully declined to honor the subpoena, on the ground that the said records were confidential communications between physicians and patients (section 352, Civil Practice Act), and on the further ground that the subpoena was too broad in scope.

The need for the service of a subpoena duces tecum on the Superintendent of the Kings County Hospital arose from a grand jury investigation into criminal abortions allegedly committed in Kings County originated by the publication in the Brooklyn Eagle of a statement by Dr. Louis N. Hellman, a Director of Obstetrics in the State University Medical Center, that there are approximately 1,200 to 1,500 abortions committed annually in Kings County Hospital and that approximately half of that number are induced abortions. Dr. Hellman was promptly subpoenaed before the grand jury, gave testimony, and in fur-

therance of the investigation, the grand jury directed the issuance of the subpoena duces tecum in question.

A similar situation arose in the matter of New York City Council v. Goldwater (284 N.Y., 296). In that case, a special committee, appointed by the City Council of the City of New York to investigate charges of negligence and maladministration in the treatment of patients at Lincoln Hospital, had issued and served subpoenas duces tecum, addressed to the Commissioner of Hospitals of the City of New York, and to the Medical Superintendent of Lincoln Hospital, requiring the production of "all case records, reports, charts, diagnosis, X-rays, and other records relating to the following patients."

The corporation counsel in that case advised the commissioner of hospitals not to produce those records on the same grounds as the corporation counsel in this case advised the Superintendent of Kings County Hospital quoting as authority for his advice, section 352 of the Civil Practice Act.

Section 352 of the Civil Practice Act is applicable in this proceeding: "Physicians, dentists and nurses not to disclose professional information. A person duly authorized to practice physic or surgery, or dentistry, or a professional or registered nurse, shall not be allowed to disclose any information which he acquired in attending a patient in a professional capacity, and which was necessary to enable him to act in that capacity; unless in cases where the disclosure of the information so acquired by a dentist is necessary for identification purposes, in which case the dentist may be required to testify solely with respect thereto, or unless, where the patient is a child under the age of sixteen, the information so acquired indicates that the patient has been the victim or subject of a crime, in which case the physician, dentist or nurses may be required to testify fully in relation thereto upon any examination, trial, or other proceeding in which the commission of such crime is a subject of inquiry."

The exception which the Legislature saw fit to make applies where the patient is a child under the age of sixteen and the information so acquired indicates that the patient has been the victim or the subject of a crime in which case the physician may be required to testify. There was no evidence in the proceedings before the grand jury indicating any fact to which the exception applied.

Section 90 of the Sanitary Code of the City of New York provides as follows: "It shall be the duty of the manager, superintendent or person in charge of any hospital, sanitarium, dispensary or other institution for the care and treatment of persons in the City of New York, and of every physician in said city to immediately notify the Department of Health by telephone of any case of abortion or miscarriage where criminal practice is discovered or suspected."

It was the district attorney's contention that in view of this section, the records called for by the grand jury subpoena are not privileged communications within the purview of section 352 of

the Civil Practice Act. With that view, the court was in disagreement.

"Confidential communications relating to abortions are not excluded from the privileges accorded by section 352 of the Civil Practice Act."

In view of the fact that the failure of the Superintendent of the Kings County Hospital to obey the subpoena was not a willful one and in view of the fact that he acted in good faith when he sought and acted upon the advice of the Corporation Counsel of the City of New York, who likewise acted in good faith, the motion to punish him for a criminal contempt of this court was denied.

(Matter of Investigation into alleged commission of criminal abortions in the County of Kings, and matters connected therewith and/or arising therefrom, County Court, Kings County, Barshay, J., N.Y.L.J., Nov. 18, 1954, P. 11).

Hospital Discharged, But Physician Held Liable For Patient's Drug Addiction.—An appeal was taken from a judgment awarding damages for injuries allegedly resulting from malpractice. The action was originally brought by Los Alamos Medical Center, Inc. against Joseph S. Coe, on account. On motion, Jean S. Coe, his wife was made a cross complainant, and Drs. Wilcox and Behney were made cross-defendants. The account was not disputed and judgment was rendered accordingly. By counterclaim, it was alleged that the Medical Center, through its employees Drs. Wilcox and Behney, negligently administered and prescribed morphine for self-administration without supervision, in such amounts and frequency as to cause her addiction. It was alleged that as a result of her addiction, her health was greatly impaired and that she suffered great pain in effecting a "withdrawal." They sought damages for such wrongful acts.

The cross-defendants filed separate answers denying her addiction and their negligence as a cause thereof. Dr. Behney further alleged that all morphine prescribed or administered by him was made upon the insistent demands of patient and husband after having warned them of the dangers incident to the use of such drug; that if he were negligent the Coes were guilty of contributory negligence as a proximate cause of the alleged injuries. Dr. Wilcox, and likewise the Medical Center, urged the same defenses as Dr. Behney. The Medical Center as a further defense pleaded immunity from liability by reason of being a nonprofit corporation, engaged in the operation of a hospital and medical center in New Mexico for the purpose of providing medical, dental and hospital services and care without profit.

At the close of the evidence, the cause was dismissed as to Dr. Wilcox. The issues were submitted to a jury which returned its verdict in favor of the Medical Center, and awarded both compensatory and punitive damages against Dr. Behney. Judgment was entered on the verdict and Dr. Behney appealed.

The evidence at the trial showed that Mrs. Coe was admitted to the hospital on several occasions. On March 28, 1950, she was admitted for dilation and curettage. She again entered the

hospital April 16, 1950 for similar treatment. On June 6, 1950, she was admitted for a major operation, separation of adhesions and supra-vaginal hysterectomy. The latter operation was performed by appellant. Subsequently, on June 13, 1950, she entered the hospital for removal of intestinal obstructions and was finally discharged therefrom July 15, 1950. During all this time she received narcotics in some form or another. It seems Dr. Behney did not perform the latter operation, nevertheless, Mrs. Coe again became his patient on July 25 and remained such until November 3, 1950, at which time she went to Los Angeles, California and entered the Good Samaritan Hospital in Los Angeles, where she was diagnosed as a morphine addict after surgery. The amount, kind and quantity of narcotics prescribed and used by Mrs Coe were shown by the hospital records.

The Coes themselves were apprehensive and discussed the possibility of addiction with appellant and he assured them that they had no cause for alarm as her pain was so severe that it would counteract the effect of the morphine. He was thus put on notice but remained indifferent as to the harmful results which followed.

The evidence is clear that Mrs. Coe in order to get a prescription, frequently complained of pain when no pain was present. She testified she used it at the last for the jitters and for nervousness, at other times just to feel good. But being fearful of its harmful effects, the Coes contacted appellant as to the consequences of using too much morphine and were told by him not to worry in this regard as Mrs. Coe was improving physically and that she could be given morphine whenever she felt the need of it. They testified they relied upon the instructions of appellant in this regard.

Specialists in drug addiction, testified on behalf of appellant to the effect that the quantity of drugs shown to have been administered to Mrs. Coe could not result in addiction and that the withdrawal of a true addict could not be accomplished within the short time required for withdrawal by Mrs. Coe. Testifying in behalf of the patient, a Dr. Norris stated that it was a simple matter to detect whether a patient is addicted to the use of narcotics.

Under these circumstances, it was within the province of the jury to evaluate and choose between the views of the experts on this question, and the court is not in a position to disturb the jury's finding of addiction.

On the question of contributory negligence, in such cases as the one at bar, it is the law that, "It is not a part of the duties of a patient to distrust his physician, or to set his judgment against that of the expert whom he has employed to treat him, or to appeal to other physicians to ascertain if the physician is performing his duty properly. The very relation assumes trust and confidence on the part of the patient in the capacity and skill of the physician; and it would indeed require an unusual state of facts to render a person who is possessed of no

(Continued on page 128)

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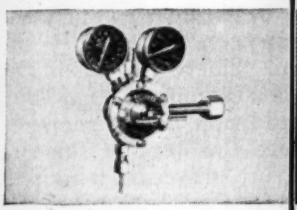

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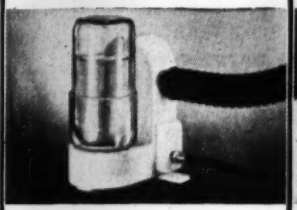

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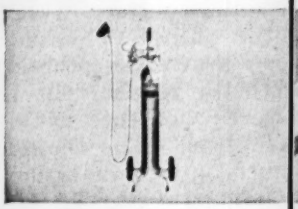

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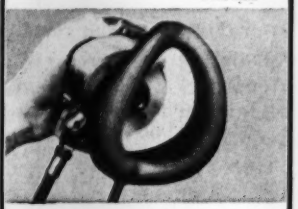

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Notes and Case Reports

About Explosions

It has been a well-known fact, since 1846 or earlier, that ether, a drug which is used to alleviate the pain of surgery, is burnable. We still use that same flammable anesthetic in combustible proportions under explosive conditions every day and probably will continue to use it, as well as other hydrocarbons which are flammable.

Since this is so, and because "ether flares" and "anesthetic explosions" have been noted in the literature since the early 1920's, the National Fire Protection Association in 1939 organized the first Conference Committee on Operating Room Hazards to look into these matters and try to devise safeguards. This group was the parent of the present Committee on Hospital Operating Rooms. Since the publication in 1944 of the first pamphlet of recommendations to ensure safety in hospital operating rooms, new facts have come to light, necessitating revisions. The latest edition of standard No. 56, "Recommended Safe Practice for Hospital Operating Rooms", was printed in 1954 by N.F.P.A.

In 1941 Hass, Hibshman and Romberger published, in "Anesthesia and Analgesia", excellent graphs showing the range of flammability of ether, ethylene and cyclopropane. These are the chief combustible anesthetics in general use today. Bulletin No. 503 of the Bureau of Mines, called "The Limits of Flammability of Gases and Vapors," by H. F. Coward and G. W. Jones, is most comprehensive and revealing.

It takes three things to make a fire. There must be something which will burn, heat to start the fire, and oxygen to support the combustion. There is also the hazard of a destructive explosion with the addition of an enclosed space, where the heat of the fire will build up pressure which is released by the rupture of something. In the case of an anesthetic explosion, this "something" may be the rubber or valve parts of the anesthetic apparatus, or the patient's respiratory tract, which is part of the anesthetic circuit during closed system anesthesia.

The anesthetic agent itself is the burnable object. Ether, cyclopropane, ethylene, etc., though they may burn only momentarily if in small amounts, can spread fire to other substances such as sheets, skin, hair, etc.

Oxygen is always present in sufficient amounts to support combustion, either in air, as with drop ether, or the oxygen used in mixtures in anesthetic apparatus.

An "enclosed space" is present when the closed system is in use.

Heat to start the fire is the problem. The other factors which contribute to a fire are necessary to the practice of anesthesia so cannot be eliminated. Heat can be eliminated and, therefore, we must do something about it.

The readily recognized sources of heat are relatively easy to prohibit or control because they are seen. Examples are: smoking, cautery alcohol burners, high frequency machines, hot lights, X-ray sparks, faulty electrical equipment and connections. But static is not in this category.

What is static? How is it formed? How can we get rid of it? Why do we have it? Why does it seem to be worse in some places and at certain times than in others? What on earth does underwear have to do with it? These are questions anesthetists ask.

According to the dictionary, "static...pertaining to forces at rest...of, pertaining to or designating stationary charges of electricity; also, producing such charges, as by rubbing unlike bodies together..."

"Statikos" is the Greek word from which our word static is derived and it means "to stand still." Applied to electricity it means electric charges at rest, stationary, and always on the surface.

When two terminals (bodies, substances) of differing potential (one high tension or potential electric charge, the other low) contact, or almost contact each other, there will be a discharge of electricity because the charge is allowed to equalize its difference of potential between the pair of terminals. The usual static discharge may be likened to lightning on a very small scale and the discharge is of extreme short duration. This discharge takes the form of an electric spark and produces heat sufficient to ignite our flammable anesthetic mixtures.

An easy way to produce static electricity is by friction; in fact static is often called "frictional electricity." This is why our clothing is important. Those who are flying enthusiasts will find it easy to think of air as having substance. This is something we must recognize because air is resistant to bodies moving through it, which means there is friction between the air and whatever is moving.

Everything we do in the operating room—walking through it, pouring water in hand basins, picking up a forceps, leaning over to open another tank on the machine, turning around on the stool to chart the B.P.—electrically speaking, is frictional, is mechanical work, and is converted into electric energy. If this electric energy is great enough (high potential or tension charge) there will be an electric discharge to the next object you touch. This equalization of charge on both surfaces may cause a spark with enough heat to ignite the flammable mixture you are using on your patient.

This spark with its accompanying heat will not occur if a difference in potential cannot be built up because you are already electrically connected with all other objects. This is the safeguard in having conductive flooring in operating rooms. However,

persons or objects insulated from the conductive flooring at any point will cause a breakdown of the whole safeguard. This insulation can occur if the floor is not kept conductive over the entire surface all the time. Wax and soap film hinder conductivity, as do pieces of equipment having non-conductive contact points, casters, brake shoes, mattress covers, sheeting, and such. Shoes and soles of stockings must be conductive and kept that way, cleaned of wax, dirt, and film of soap. Slips, made of substances such as nylon, which flare away from the body are not conductive. Many things may break down the conductive safeguard and only eternal vigilance will keep the conductive circle unbroken and safe.

HARRIET L. ABERG
A.A.N.A. Representative to National Fire Protection Association's Committee on Hospital Operating Rooms

LEGISLATION

(Continued from page 124)

medical skill guilty of contributory negligence because he accepts the word of his physician and trusts in the efficacy of the treatment prescribed by him. A patient has the right to rely on the professional skill of his physician, without calling others in to determine whether he really possesses such skill or not. The patient is not bound to call in other physicians, unless he becomes fully aware that the physician has not been, and is not, giving proper treatment."

The jury was instructed that if it should find that the Medical Center was a non-profit corporation and there had been no distribution of profits derived from its operation or from the medical services furnished by it, the Medical Center was not liable for the acts of its agent, Dr. Behney. The judgments were affirmed.

(Los Alamos Medical Center, Inc., v. Coe, 4 C.C.H. Neg. Cases (2d) 42-N.M.)

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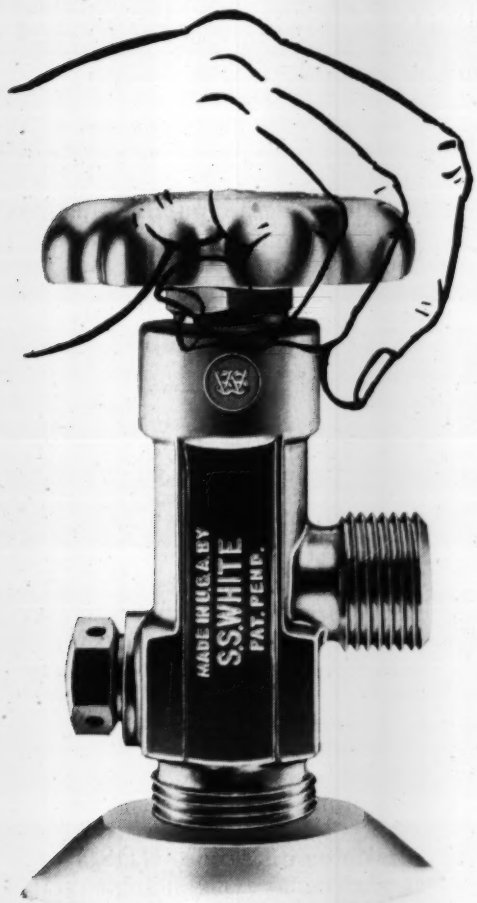

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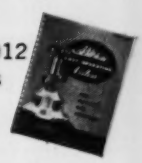

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Abstracts

DiPalma, J. R.: The pharmacology of N-(4-methoxybenzyl)-isoquinolinium chloride, WIN 2173, with particular reference to its cardiac effects. J. Pharmacol. & Exper. Therap. **113**: 125-131 (Feb.) 1955.

"Isoquinolinium compounds have been little studied for their cardiac effects. Most compounds representative of this group are ganglionic blocking or curare-like agents. . . . N-(4-methoxybenzyl)-isoquinolinium chloride is an aromatic quaternary ammonium compound which has weak ganglionic and neuromuscular blocking effects. Its main action is a positive inotropic and chronotropic effect on the heart which has been demonstrated in this investigation on isolated cat atrium, intact dogs and humans. Local anesthesia comparable to that obtainable by procaine is produced by intradermal injection. However, WIN 2173 produces a local reaction suggestive of histamine release. Uulike quinidine and similar drugs, WIN 2173 does not protect against epinephrine-hydrocarbon induced arrhythmias. However, it is much more potent than quinidine in raising the threshold of electrically induced atrial fibrillation in the cat. The drug is well tolerated in intact unanesthetized animals and humans provided the dose does not exceed 5 mgm./kgm. intravenously or intramuscularly. Dilation of the pupils, flushing and occassionally vertigo are encountered in humans but are transient. The clinical trial for the cure of human arrhythmias will be the subject of a future report."

Bauer, R. O., Graves, W. H., Jr., Hill, C. S. and Milch, L. J.: Acute experimental hemorrhagic shock in the dog treated with subcutaneous hyaluronidase-dextran solution. Proc. Soc. Exper. Biol. & Med. **87**:341-343 (Nov.) 1954.

"Dextrans, injected subcutaneously with hyaluronidase, have been demonstrated in the thoracic lymph of normovolemic cats and dogs. . . . . It was the purpose of this work to determine if similarly prepared hypovolemic animals would survive following early subcutaneous administration of either dextran hyaluronidase physiologic saline (DSH) or hyaluronidase physiologic saline (PSH). Subcutaneous replacement therapy might have significant importance after national catastrophes when hemorrhage from blast injury might be expected in large numbers of the population. Inexperienced hands, under emergency recruitment, would find intravenous administration difficult, if not impossible. . . . Seventy-nine dogs were exsanguinated to respiratory arrest and, after 60 to 90 seconds, rein-

fused with 25% of hemorrhaged blood. Twenty-four control dogs received no further treatment and half of this number survived 24 hours. Physiologic sodium chloride solution with hyaluronidase (PSH) was administered subcutaneously to 27 animals and 6% dextran in physiologic sodium chloride-hyaluronidase (DSH) to the remaining 28.93% of the dogs treated with physiological saline-hyaluronidase were alive after 24 hours, whereas only 50% survival was recorded for the dextran group."

LANGFORD, H. G., BERNHAUT, MAXINE AND HOFF, E. C.: Effects of pentobarbital and ether upon vasomotor responses from cerebral cortex of the dog. Proc. Soc. Exper. Biol. & Med. 87:561 563 (Dec.) 1954.

"Blood pressure responses from the cerebral cortex of the dog have not been studied as extensively as those evoked by stimulation of the cortex of the cat and the monkey. The reports available are conflicting. . . . As a further indication of the action of anesthetics upon the blood pressure responses to cortical stimulation in the dog, the present study affords evidence of differential effects of pentobarbital and ether upon the cortical autonomic response mechanism. . . . Electrical stimulation of the anterior cerebral cortex of the dog under pentobarbital anesthesia gives predominantly depressor responses. Under ether anesthesia the response is usually pressor. Some stimuli are followed by a rise of blood pressure of one or 2 minutes duration, while others are accompanied by only 15 to 20 seconds of pressure elevation. The mode of action of these anesthetics in affecting the cortically induced blood pressure response is not understood."

ANDERSON, P. O. AND CINCOTTI, J. J.: An anesthesia bronchospirometer valve. J. Lab. & Clin. Med. 45:493-494 (March) 1955.

"A study of individual lung participation from the period immediately preceding the induction of general anesthesia and discontinuously throughout thoracic surgical procedures has been carried out. . . . During this study the need for easy rapid switching from the anesthetic, bronchospirometric, or suction circuits for either lung led to the construction of a simple, light, easily cleaned, leak-proof, four-way valve which can be sterilized by autoclaving. All orifices of the valve have internal diameters of 7mm. Two such valves are used side by side with each valve permitting control of one lung, independent of the other. . . . This anesthesia bronchospirometer valve affords a convenient method for the study of individual lung function during anesthesia and surgical procedures. Spirometer tracings ensure that isolation, in fact, obtains and additionally serves as a discontinuous record of individual lung tidal and minute-volume ventilation and oxygen uptake. Relaxation volumes and mid-position changes may be recorded. The suction orifice permits unhurried, unilateral evacuation of bronchial secretions."

Book Reviews

Textbook of Pediatrics. Edited by Waldo E. Nelson, M.D., Professor of Pediatrics, Temple University School of Medicine, Medical Director of Saint Christopher's Hospital for Children. Cloth. Ed. 6 1581 pages, 122 tables, 438 illustrations. Philadelphia and London.: W. B. Saunders Company, Publisher, 1954.

This book is a continuation of the Griffith, Griffith-Mitchell and Mitchell-Nelson series of textbooks of pediatrics. Following the plan originally laid down by Dr. Griffith and Dr. Mitchell, those authors' names have been dropped with this edition. Seventy authors have contributed sections of the book which is designed primarily for students and practitioners interested in the medical care of children.

There are many of the chapters that will be of interest to anesthetists. Of particular value would be the excellent chapter on **Disturbances of Fluid and Electrolyte Equilibrium** by George M. Guest; **Parenteral Fluid Therapy** by Katherine Dodd; **Anesthesia for Children** by Curtiss B. Hickcox; **Care of Premature Infant** by Clement A. Smith and **Diseases of the Newborn Infant: Full Term and Premature** by Waldo E. Nelson whose name appears as editor. The brief but useful chapters on **Special Considerations of Neonatal Therapeutics** and the chapter on **Heart and Circulation in Health and Disease** as well as many others will meet the need of many anesthetists who often deal with the pediatric patient.

Drugs in Current Use. Edited by Walter Modell, M.D., F.A.C.P., Associate Professor, Clinical Pharmacology, Cornell University Medical College, Linen. 147 pages. New York, New York.: Springer Publishing Company, Inc., Publisher, 1955. $2.00.

An alphabetic listing of all drugs that are currently being used is presented by the author for the purpose of presenting "a capsule-account of the data essential to the sensible exploitation and safe handling of a drug." In a small linen-covered book utilizing dictionary style of two columns to each page, subjects are readily located. Pharmacopeial drugs are indicated by the designation, U.S.P., National Formulary by N.F., and proprietary names are followed by the symbol ®. Proprietary names and synonyms are used in some instances. The editor has sometimes selected one proprietary name over another for purposes of brevity. The metric system is used for giving all dosages; however, so that dosage may be transposed to the apothecary system, conversion tables are included. Trade names are listed and cross reference made to the official names. A great deal of useful information is contained for each of the drugs. It is the intention of the author to keep the volume up to date by annual revisions, and with the impending discontinuance of the New and Nonofficial Remedies it would seem that this book would have an increasing usefulness.

NERVE BLOCKS. A Manual of Regional Anesthesia for Practitioners of Medicine. By John Adriani, M.D., Director, Department of Anesthesiology, Charity Hospital of Louisiana; Professor of Surgery, Tulane University of Louisiana, School of Medicine; Associate Clinical Professor of Surgery, Louisiana State University School of Medicine, New Orleans, Louisiana. Cloth. 265 pages, 168 illustrations. Springfield, Ill.: Charles C Thomas, Publisher, 1954. $6.50.

Following the pattern of his previous book **Techniques of Anesthesia**, the author has presented general considerations and specific directions for administering nerve block anesthesia. This has been done since the demand for nerve blocks is no longer limited to anesthesia but is used also for diagnostic and therapeutic purposes. Each chapter of the book is followed by references. There are numerous drawings and photographs. Tables at the end of the book list blocks that are used to perform surgical procedures, and in a separate table those that are "used, recommended or are alleged" to be of value in diagnostic and therapeutic purposes. For a good understanding of the problems of regional anesthesia, nurse anesthetists may find the first section particularly useful. In this section the drugs, materials, preparation of the patient and conduct of various aspects of regional anesthesia are given in detail.

THE USE OF TRILENE BY MIDWIVES. By The Medical Research Council Committee on Analgesia in Midwifery, London. Paper. 34 pages, 14 Tables. London: Her Majesty's Stationary Office, Publisher, 1954. 2s.

This paper covered booklet was prepared as a result of the investigation into the use of Trilene as an analgesic in labor. In 1949 a committee was appointed to investigate the problem of administration of Trilene by midwives and "to advise and assist in promoting research on the possibility of devising improved or new methods of producing analgesia, suitable for use by midwives". Various inhalers were tried in local health authority units and hospitals representing a sample of urban and rural midwifery practice in various parts of the country. The results of the study are presented in the pamphlet with many tables outlining the methods and the effects both on mother and child. Specifications for trilene apparatus for use by midwives are listed in an appendix. Recommendations are made for the use of Trilene by midwives.

KOREA

(Continued from page 117)

cessful completion of major surgical procedures, particularly in the fields of thoracic and neurosurgery, which hitherto would not have been attempted with any hope of successful completion and survival of the patient.

When spinal anesthetics are called for, we use 100-150 mg. Procaine or 10-12 mg. Pontocaine. For local anesthesia we use 1 or 2% Procaine.

Classified Advertisements

NURSE ANESTHETIST WANTED Excellent working arrangement, good pay. Apply to Bernard Goldstein, M.D., Director of Anesthesia, Albert Einstein Medical Center, Southern Division, Fifth & Reed Sts., Philadelphia 47, Pennsylvania.

REGISTERED NURSE ANESTHETISTS: 40 hr. week, permanent positions open for surgery and obstetric departments. Liberal vacation and sick leave policies. Social security, overtime pay, extra pay for night duty. No call duty. Automatic pay increases. Apply: Chief Nurse Anesthetist, Harper Hospital, Detroit 1, Michigan.

REGISTERED NURSE ANESTHETIST: 135 bed general hospital in charming southern city of 18,000 short drive from Gulf of Mexico. Well-qualified surgical staff. Salary range $380-$416 a month commensurate with experience. 4 weeks vacation with pay, sick leave. 2½ day weekend every 4th week. Apply: Administrator, John D. Archbold Memorial Hospital, Thomasville, Georgia.

WANTED: Surgical Anesthetist for 150 bed general hospital central Nebraska. Excellent working conditions and personnel policies. $450 per month and full maintenance. Apply: Box M-28, Journal American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Ill.

CHIEF NURSE ANESTHETIST WANTED: 400-bed general hospital doing obstetrical and surgical anesthesia. Salary $450 per month plus complete maintenance. Apply: Peoples Hospital, Akron, Ohio.

WANTED: Registered Nurse Anesthetists. Contact, M. Sanders, Director McLaren General Hospital, 401 Ballenger Highway, Flint 2, Mich.

NURSE ANESTHETIST: Approved hospital near Detroit. $475 per month. Overtime after forty hours per week. Living quarters available. Wyandotte General Hospital, Wyandotte, Mich.

WANTED: Registered nurse anesthetist. Fully approved small, privately-owned hospital located in the Midwest. Salary open, vacations with pay. Excellent working conditions. Contact Mrs. Geraldine Walden, Superintendent. A.C.H. Hospital, Shawnee, Oklahoma.

NURSE ANESTHETIST: For modern air conditioned 5 room operating suite, to work under anesthesiologist. Contact: Assistant Administrator, Mount Sinai Hospital, Minneapolis Minnesota.

NURSE ANESTHETIST wanted to complete staff of five in 230 bed hospital in Western Pennsylvania city of 50,000. Write Marjory Walker, Chief Anesthetist, Jameson Memorial Hospital, New Castle, Pa. for particulars.

WANTED: Nurse Anesthetist - 75 bed hospital in industrial center. Salary $500.00 per month plus part maintenance. Keizer Memorial Hospital, North Bend, Oregon.

WANTED: Nurse Anesthetist for 800 bed teaching hospital. Staff of 4 Anesthesiologists, 2 Fellows, 4 Residents, and 9 Nurse Anesthetists. Beginning cash salary $4,512 annually with merit rating increases, one month paid vacation, 15 days sick leave annually, which can accumulate to 90 days; only emergency operations on Saturday. Please reply to Anesthesia Department, Medical College of Virginia, Richmond 19, Virginia.

POSITION OPEN: Nurse anesthetist - excellent opportunity - 275 bed hospital - APPLY: Robert M. Murphy, Administrator, Lima Memorial Hospital, Lima, Ohio.

A position for a Nurse Anesthetist is available at the Cleveland Veterans Administration Hospital, 7300 York Road, Cleveland 30, Ohio. Applicant must have had training in an approved school and be a member of the American Association of Nurse Anesthetists. Department staff includes one physician and five nurse anesthetists.

NURSE ANESTHETIST: Excellent opportunity, with great variety of surgery and anesthetic procedures. Recent graduate acceptable. Address replies to: Dr. Peter G. Lehndorff, Burbank Hospital, Fitchburg, Mass.

NURSE ANESTHETIST WANTED: For obstetrical anesthesia in department averaging 250-300 deliveries monthly. Salary $400 month plus complete maintenance, including room, meals, phone and laundry. Vacation and sick time granted. Apply: Peoples Hospital, Akron, Ohio.

NURSE ANESTHETIST: Accredited modern 200-bed hospital. Department directed by Anesthesiologist, assisted by three nurse anesthetists. Pleasant working conditions, hours, paid vacation, social security, group insurance and retirement plan. Excellent staff of surgeons. Good salary and merit increases. Apply to: May Aileen Davies, M.D., La Crosse Lutheran Hospital, 1910 South Avenue, La Crosse, Wisc.

ATTRACTIVE POSITION FOR NURSE ANESTHETIST: Apply to Leah Camp, M.D., Franklin Square Hospital, Baltimore 23, Maryland.

TWO NURSE ANESTHETISTS wanted immediately to increase staff in 300 bed general hospital. Salary depending on experience. Present staff of two anesthesiologists and four nurse anesthetists. Write to Richard E. Allen, Director, Dept. of Anesthesiology, The Memorial Hospital, Wilmington, Del.

WANTED: Nurse Anesthetist for 130 bed general hospital, well equipped and fully approved. Surgery is air-conditioned. Salary $525.00 per month, partial maintenance. One other anesthetist is employed by hospital. Excellent working conditions. Apply: Sister M. Albertine, Surgical Supervisor, Warner Brown Hospital, El Dorado, Arkansas.

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TWO NURSE ANESTHETISTS: New 225 bed General Hospital. Medium sized town 60 miles east of Pittsburgh. Excellent working conditions and personnel policies. Very good salary. WRITE: Robert L. Seifert, Personnel Director, Mercy Hospital, Johnstown, Pennsylvania.

ANESTHETIST: Nurse - 140 beds, general hospital in city of 50,000. Excellent working conditions. Salary $400-$500 per month. Write Administrator, Finley Hospital, Dubuque, Iowa.

NURSE ANESTHETIST wanted for oral surgeon's office. Experience necessary. Salary, $300.00 to start, 40 hour week. Pleasant working conditions. Reply to: Mrs. Howell T. Hunt, Anesthetist, 1032 Maison Blanche Building, New Orleans, Louisiana.

ANESTHETIST: $400.00 starting salary, plus complete maintenance, including 28 days vacation per year. Liberal personnel policy. College town. Apply Administrator, Centre County Hospital, Bellefonte, Pa.

Position available immediately. Permanent or summer relief - 200 bed hospital. Paid vacations, sick leave and Social Security. Medical Anesthesiologist in charge. Apply: Sister Mary Concetta, St. Joseph Mercy Hospital, Pontiac, Mich.

NURSE ANESTHETIST - A.A.N.A. member. Two outstanding openings - one in Chicago, Illinois and one in Indiana. Good personal policies - salary - open - 40 hour week - Residential area. Contact E. D. Strzelecki Adm. Asst. - Little Company of Mary Hospital, Evergreen Park, Illinois.

NURSE ANESTHETIST for 100 bed general hospital - thirty miles east of Houston - on call every third weekend, rotating OB call with two other anesthetists. Good salary, San Jacinto Memorial Hospital, Baytown, Texas.

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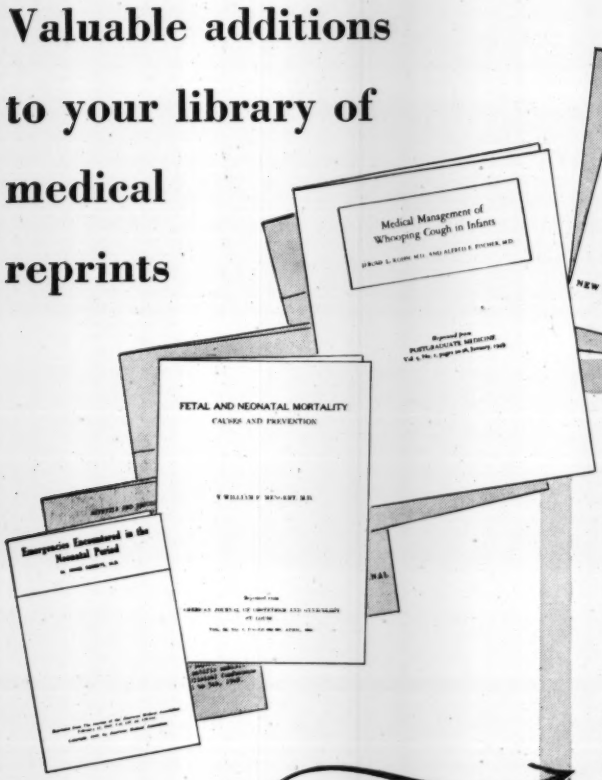

1. "Care of the Toxic Newborn," Russ, J. D.: NEW ORLEANS MED. AND S. J. 101: 292-294 (Dec.) 1948.

2. "Emergencies Encountered in the Neonatal Period," Roberts, M. H.: J. A. M. A. 139:439-44 (Feb. 12) 1949.

3. "Fetal and Neonatal Mortality: Causes and Prevention," Mengert, W. F.: AMER. J. OBST. AND GYN. 55:660-668 (April) 1948.

4. "Medical Management of Whooping Cough in Infants," Kohn, J.L. and Fischer, A.E.: POSTGRAD. MED. 5:20-26 (Jan.) 1949.

These articles, which discuss the use of oxygen in medicine, are available from LINDE's oxygen therapy department.

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